SPECIAL RADIO NUMBER

Science and Invention

July

25 cents

FORECASTING WEATHER BY RADIO

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A. G. Hughes, Kentucky.
"I went out two days last week on home portrait work and made $97.00. I very often sell an enlargement for $10.00."

John Tutterway, W. Va.
"I learned more about photography from your first twenty lessons than from the 5 years I tried to train myself from photographic books."

E. D. Blacet, Ohio.
"On Christmas I made a family portrait and handled the job so professionally that I was paid more than the price of your entire course."

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"I have been able to buy my house and lot from the sale of pictures alone. I sold the pictures of a recent flood for $100.00."

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Like hundreds of others, you can train *at home* and establish a business of your own which will make you independent.

TREMENDOUS, big paying opportunities are open for every man who knows Modern Photography. Magazine and newspaper publishers buy thousands of photographs a year. Thousands of manufacturers use pictures in taking orders for their products. Every home wants portraits. Photography is a business running into millions of dollars annually. Yet there is an actual scarcity of trained men.

Easy to Earn $3,000 to $10,000 a Year

I want to show you letters from hundreds of men who are becoming independent through this fascinating profession. Do you know that right now there are over 35,000 splendid locations waiting for ambitious men to start their own business? Hundreds of big paying positions are also open. *During spare time alone* while taking this course you can make $75.00 a week. Others are doing it. It makes no difference whether you live in the country, small town or city.

QUALIFY
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Newspaper Photographer
Aerial Photographer
Commercial Photographer
Studio Manager
Portrait Photographer
Motion Picture Operator
Architectural Photographer
Expert Retoucher
Landscape Photographer

No Experience Necessary

Many of my most successful students will tell you that it makes no difference if you never took a picture in your life before. My simple, easy, practical training will enable you to have a successful business in a few months. You need only a common school education to succeed.

Train With a Leading Photographer

As Director of the International Studios, Inc., I know just the kind of training you need to be successful in this line of business. I show you how to do the actual work yourself. Anyone can learn to take good pictures. Then it is only a step to modern professional work. If you want to get big prices, you must know how to take pictures that sell.

I Guarantee to Satisfy You

I am absolutely positive that I can train you to make big money. Therefore I guarantee under bond to return every cent of your tuition if you are not thoroughly satisfied with my training.

Professional View Camera: FREE Now

I give every student a splendid big size Professional View Camera, absolutely free. With it you do modern professional work right from the start —also charge modern prices.

Mail Coupon for Unusual Offer

For a short time I am making a most unusual proposition to ambitious men who like to take pictures. This offer will be withdrawn without notice. So mail coupon today. I will also send you full information on how to make big money in modern photography including a complete description of the free camera.

SEND THIS NOW

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Without obligation send me facts and figures on photography and your temporary offer FREE.

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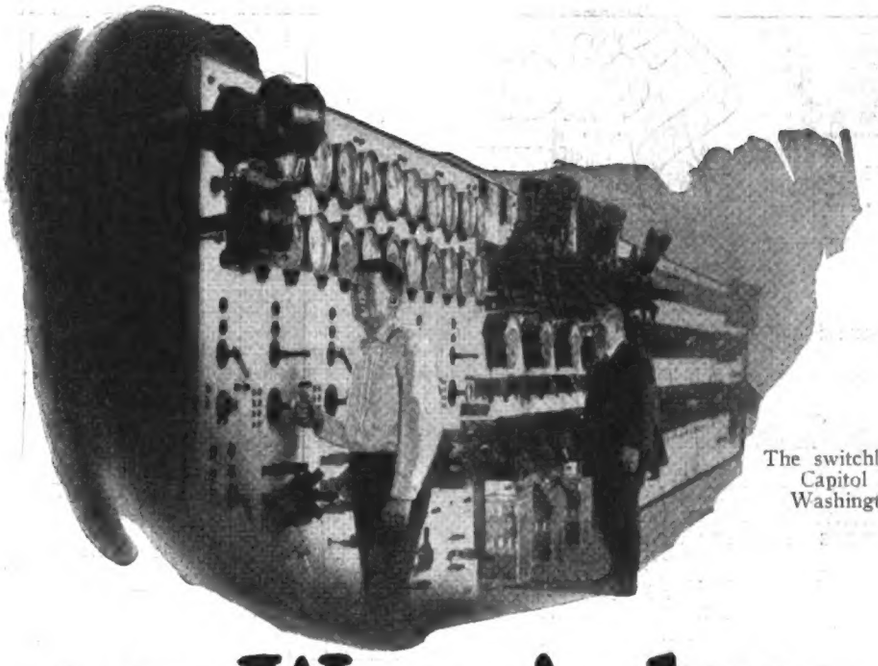

The switchboard in the Capitol Building, Washington, D. C.

Electricity Wants Ambitious Men Will Pay $3500 to $10,000 a Year

Your one chance to earn the biggest money of your lifetime is before you. No matter what you are doing now—No matter what you earn—Here is your opportunity to earn from two to ten times more.

Be a Certified Electrical Expert

Stop right where you are. The big pay field of Electricity needs you. The world's fastest growing industry is crying for men—trained men. It must have more Electrical Experts—men capable of earning from $70 to $200 a week. It needs thousands of such men right now and each year the demand is greater and greater.

Cash In On the Big Demand

You can quickly become an Electrical Expert. I have made it easy for you to earn $3500 to $10,000 a year. You learn without losing an hour's time from your present work. Get into this big-pay game now and start making some real money. Over one billion dollars will be put into electrical expansion every year for the next ten years and thousands of men are needed in all branches to carry out this work. They can't come up from the ranks fast enough or good enough. They must come from other lines and be specially trained.

A Job You Like With Big Pay

If you are ambitious to earn more money—If you want a job you can be proud of—If you want to rise high in one of the world's greatest professions—let me show you how amazingly easy it is to do it. Let me show you how quickly you can learn to earn $3500 to $10,000.

Look What Other Men Are Doing

J. W. Morgan of Delaware, Ohio, averages $45.00 a day as an Electrical Expert. He used to earn $5.50 a day as a carpenter's helper. W. E. Pence, formerly a $35 a week man, made almost $10,000 last year doing electrical work in a town where he didn't think he could make a dime before he started. Harold Hastings, a twenty-one year old lad at Somers, Mass., thought a man had to be a born genius to be anybody in electricity but he cleans up $480 a month. Joe Cullari of Trenton, N. J., increased his income over 300% in one year and frequently made more than the cost of his training in one day's time.

You Have the Same Opportunity

Not one of these men or the thousands of other men I have helped into fine big jobs had any advantage over you. They were just ordinary every day sort of fellows who wanted to earn more money. I showed them where the big money is and how to earn it and they are getting it. What I have done for these men I can do, and will do for you, because the jobs are already waiting for you—all you need is *training*.

What's Your Future?

At the rate you are going now where will you be in five years or ten years? The chances are you won't be a dollar better off than you are now. But with a training in electricity you can have everything a "he" man would want. Age, lack of education, or experience makes no difference. You don't have to be a wizard—a know-it-all. If you have average intelligence and can read and write, that's all there is to it. In a few short months, with my training, you can be an electrical expert, capable of earning $12 to $30 a day anywhere you want to go.

"Your Course Is Wonderful"

Some of my former students say my training is "wonderful." They praise it to the skies. There is nothing wonderful about it though. It's just a matter of knowing what men need from twenty years of engineering experience and then giving it to them. I have employed thousands of electrical men myself in days gone by and I know what men need. My course is the outgrowth of this wide experience—boiled down and simplified so it is easy to learn. That's why "Cooke" trained men succeed where others fail. That's why "Cooke" trained men are snapped up for fine big jobs as fast as I can turn them out.

"Vital Facts"—Big Book Free

Send for my big illustrated book—it's *free*. Over 100 interesting pictures and the "Vital Facts" of the Electrical Industry. With it I will send you full particulars of the most successful home study course ever produced, a sample lesson, my guarantee bond, complete description of the big outfit of tools, electrical apparatus, motor, etc., that I give to my students absolutely free and a credit check for $45.50. (The check is for a limited time only.)

Mail Coupon NOW

Send for this material right now. You won't be obligated in any way. You will find my book so interesting it will more than repay you for the trouble of mailing the coupon. With everything before you then, you can determine whether you want to continue in a humdrum, small pay job or be a full fledged electrical expert earning $3500 to $10,000 a year in a field where there is a job already waiting for you. Don't turn this page until you have clipped and mailed the coupon. This very second may be the turning point of your life. Do it now while the impulse to better yourself is upon you.

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Chicago Engineering Works
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Vol. XI
Whole No. 123

Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER

July, 1923
No. 3

PUBLICATION OFFICE: 542 Jamaica Ave., Jamaica, N.Y.
EDITORIAL & GENERAL OFFICES: 53 Park Place, New York City

Published by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y).

Publishers of SCIENCE AND INVENTION, RADIO NEWS, and PRACTICAL ELECTRICS

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SCIENCE AND INVENTION is published on the 25th of each month. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries $3.00 a year. U. S. coin as well as U. S. Stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addressed to Editor, SCIENCE AND INVENTION, 542 Jamaica Avenue, Jamaica, New York, or 53 Park Place, New York City, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulation.

New York City. General Advertising Dept., 53 Park Place.

Western Advertising Representatives, Finucan & McClure, 720 Cass St., Chicago, Ill.

Pacific Coast Advertising Representatives, A. J. Norris Hill Co., Hearst Bldg., San Francisco, Calif.

Kansas City Advertising Representative, George F. Dillon, Republic Building, Kansas City, Mo.

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CHEMISTS PREDICT STARTLING NEW ERA
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Light Like Firefly's May Be Produced by Chemistry, American Society Hears.
DEMAND FOR INDUSTRIAL CHEMISTS INCREASING.
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AMERICA'S FUTURE BEFORE CHEMISTS
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CHEMICAL SCIENCE MAY CUT SHOE PRICES
New Methods in Tanning to Be Discussed by Experts at Meeting of American Society.
4,000 EXPERTS TO ATTEND
CHEMISTS CHANGE ALCOHOL INTO HIGH QUALITY SILK
Government Experiments Set Pace for New Industry Already Under Way and Patient Silkworm May Lose Popularity
CHEMISTRY EXPERT HEADS 'CLEAN CLOTHES' COLLEGE
In Eleven Weeks He Teaches How to Remove All Traces of Hardship From Linen and Makes Student a Real Laundryman.
CHEMISTS IN MONTREAL LEARN OF NEW GLASS
Said to Admit Unlimited Light and Bar All Heat.

The United States Needs Chemists

What did America get out of the War? You often hear that question asked, yet few people realize just what material advantage the United States did gain. She gained industrial supremacy. Hundreds of manufactures formerly almost unknown here, have come to this country to stay. With hardly an exception they belong to the so-called Chemical Industries, for which the services of trained chemists are essential. The dyestuff industry alone gives employment to thousands of chemists, for whom there was little demand prior to 1914. Outside of the laboratory there are innumerable executive positions which can be filled only by men who understand chemistry.

The salaries of chemists are good, and the work is fascinating. Opportunities are plentiful for independent work in agriculture, medicine, food purification, water supply, the development of patents, and countless other fields.

Now is the time to get into this fruitful profession while it is yet uncrowded.

Learn Chemistry at Home

Dr. T. O'Conor Sloane, the eminent scientist, will teach you Chemistry in your own home. You do not need to give up your present employment; the lessons may be studied in your spare time. Dr. Sloane has written the course in a simple yet comprehensive way. His many years of teaching and practical experience are placed at your disposal. The lessons and experimental work are so entertaining that it becomes a pleasure to study. No previous schooling is required. The course gives you as thorough training in general chemistry as you would have obtained in college. It is indorsed by leading scientists and educators, and is considered the most unique course of its kind ever presented.

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You can pay in small monthly amounts as you go along. The price of our course is very reasonable, and includes everything necessary for its completion. There are no textbooks to buy extra, and the chemicals and apparatus used for experiments are supplied without additional charge to the student. Our plan places an education in chemistry within the reach of everyone.

EXPERIMENTAL EQUIPMENT

Given to Every Student Without Additional Charge

The experimental outfit illustrated here is furnished to every student. It comprises 42 pieces of apparatus and 18 chemicals, all enclosed in a hinged box which is itself a useful laboratory accessory.

The Value of Chemistry

Did you know that aluminum formerly cost over $100 a pound? In 1886 an American chemist, C. M. Hall, discovered a cheap method for extracting it from its ores, which brought the price down to 25 cents a pound!

Did you know that carborundum, the universal abrasive was unknown until E. A. Acheson, another American chemist, discovered it in 1891?

Did you know that silicon, an important ingredient of special steels, fell from $100 an ounce to 10 cents a pound, due to a cheap method of production evolved by American chemists?

Did you know that the dye, indigo, dropped from $4.00 a pound to 15 cents a pound when the chemists learned how to prepare it in the laboratory?

Did you know that between 1914 and 1917 the American dye exports jumped from 2 million to 57 million pounds?

Did you know that vanillin, the flavoring principle of vanilla, was reduced in price from $800 a pound to $10 a pound when chemists perfected a method for its synthesis?

Did you know that John Hyatt, an American chemist, invented the useful commodity, celluloid?

Did you know that Thorium Nitrate, used in gas-mantles, sold for $200 a pound in 1895? In 1916 it was priced at $2.60 a pound, due to improved chemical methods of refinement.

These are only a few of countless instances where Chemistry has revolutionized industry. The same chance awaits you if you will master the science.

Chemical Institute of New York, Inc.
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Dr. T. O'Conor Sloane Will Teach You

T. O'CONOR SLOANE
A. B., A. M., Ph. D., LL. D.

Noted instructor, lecturer and author. Formerly Treasurer of the American Chemical Society, and a practical chemist of vast experience, with many valuable achievements to his credit. Dr. Sloane has taught and practiced Chemistry for a great many years. He is now Educational Director of the Chemical Institute of New York. All of our students receive his personal instruction and supervision of their training.

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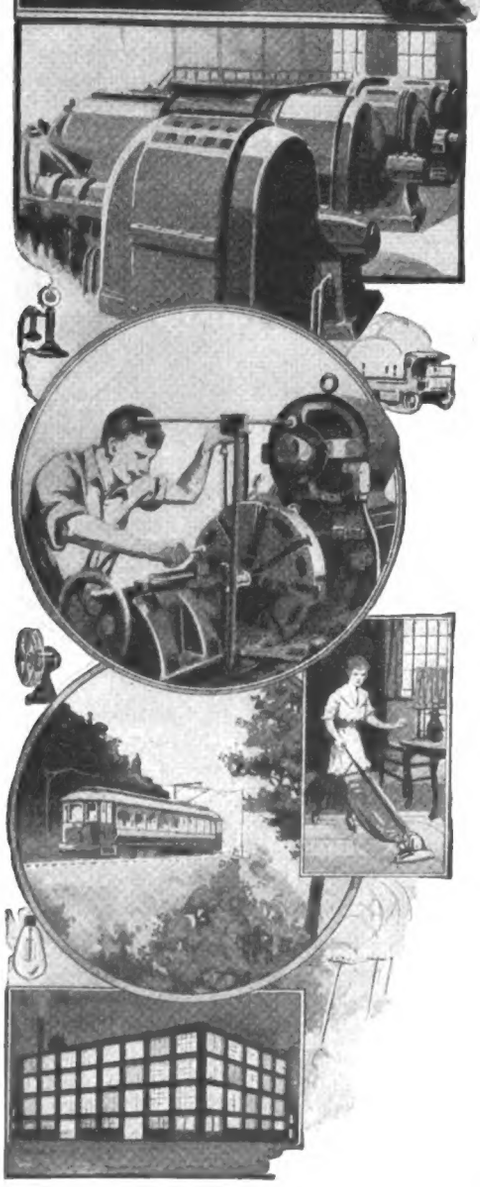

Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing.* That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business methods and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

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The N. Y. E. S. gives a special Automobile Ignition Course as an advanced training for Auto Mechanics, Garage Men and Car Owners. The course covers completely all Systems of Ignition, Starters, Lighting and other electrical equipment on automobiles, motor boats, airplanes, etc.

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Scientific Fun at Coney Island

MR. and Mrs. Pleasure Seeker were taking their annual trip to Coney Island, and of course they desired to see what Luna Park looked like, not having been there since the last time we reported their visit. Luna Park was dressed up in great style. The swimming pool which was formerly housed in completely, was now open, and a veritable inland beach had been created, so that the bathers could mix with the passers-by. Now and then some of the spectators got too close to the bathers and were rewarded by a drenching—but that was all in the day's fun. In back of the pool was the new "Pit," an installation of Herbert N. Ridgway.

THE "PIT"

This they promptly visited. On entering the doors they came right in line for a group of tortures. They ascended a flight of rickety stairs, which would not behave. The stairway acted like a bucking broncho, and tried its best to toss both Mr. and Mrs. Pleasure Seeker down the flight, but they held on like grim death, because if they had let go, it would mean just what it seemed. At the top of the stairway they passed through a turnstile, and much to their amazement found that they could not turn back, and that they were on a miniature stage, the eyes of five hundred or six hundred people riveted upon them. Naturally they had to make the best of the situation, so with firm step they walked forward on to a floor in which two long cylindrical drums were revolving in opposite directions, but toward each other. Their journey across this section was not as dignified as they would have liked to have had it, because their legs seemed to have a peculiar habit of trying to form letter X's. From this they staggered upon a floor over which an endless belt was running. They made but small progress. In order to reach the end of the belt, they decided to increase their pace, but as they did so, the speed of the belt increased, and soon they found themselves standing still relatively with regard to the stage (apologies to Einstein), even though they were running as fast as they could in trying to reach the end of the section. Now, when they least expected it, the direction of movement of the belt was reversed and amide roars and screams, they picked themselves up from the floor as gracefully as they knew how. A little further on the floor sunk beneath their weight, and when they were well down to the bottom of the trap, the floor suddenly rebounded, throwing them into the air. Frequently Mrs. Pleasure Seeker found it difficult to keep her dresses down, as they seemed to have a tendency to rise due to the action of air blasts, while the head of the family was longing for a bottle of glue, or a rivet or two, or perhaps even a rubber band to keep his hat fixed to his head. Both Pleasure Seekers then entered the tumbling barrels. These are immense eight foot barrels revolving rapidly, and the trick is to get through them without falling. One seldom does, primarily because one of the barrels revolves in one direction and the other in the opposite direction, and they are bound to create that topsy-turvey feeling before the end of the passage.

A suspended bridge permitted our party to cross until they were almost in the center of it, when a false step on the part of one of them caused the bridge to sway, and the journey was completed with the stagger step, so familiar before prohibition times. A descending incline about one hundred feet long, was next attempted. This is made of wood and suitably provided with an uprising bump near the center. From this point on a polished steel sheet completes the slide. Down they went at a terrific speed, the bump threw them into the air, and it seemed as through the time required to reach the bump was not even a second. The remainder of the journey grew in excitement. They landed in a large circular bowl, with sides as smooth as glass. It was impossible to crawl out; the only way to free themselves would have been to drop a rope into the center of the bowl and hoist themselves out or run around and around, until assisted by centrifugal force they reached the top of the bowl. A little further on they stepped on a large tread wheel or disc, where they found that regardless of how rapidly they traveled, they were always at the bottom of this wheel and could not reach the goal. This disc was mounted at an angle and ran in ball bearings. The human roulette wheel at last tossed them off and came nigh leaving a mass of human wreckage, but when they got through with attempting to upset each other in the upsetting barrels, they discovered that they had crammed a year's exercise into the space of half an hour.

From here they entered "The Love Nest."

THE LOVE NEST

This resembles a large inclined merry-go-round beautifully decorated and provided with a series of portals opening into dark alleyways resembling mystic mazes. Staggering through one maze, they found that it terminated at a blind end, and they had to retrace their steps. Entering another portal on this rotating wheel they were similarly greeted. Finally they came to one which led directly to The Love Nest. Here they entered a door labeled "Elevator." Around and around they whirled. Suddenly their seats gave way under them, and they were precipitated from the revolving disk along a rather bumpy passageway. The seat in this elevator cannot collapse until the entire wheel is in alignment with the slide leading to the exit. (See illustration.) On another ride they seated themselves in cars having slotted floorings. As this rotated over a hill and dale road, an awning suddenly closed over them. Blasts of air created considerable commotion in the cars and when they were busy rearranging themselves, the canopy suddenly flew open, permitting all the spectators to gaze on their discomfort.

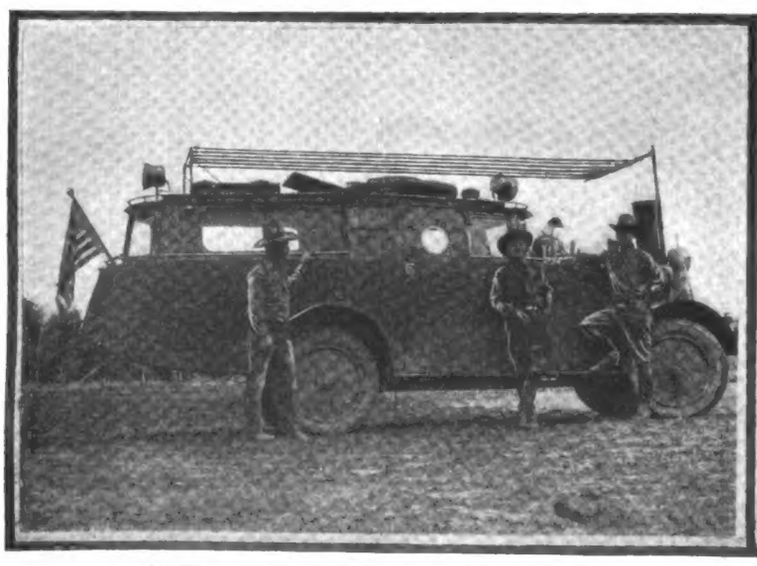
Yachting Ashore

By MYRTLE GROVE

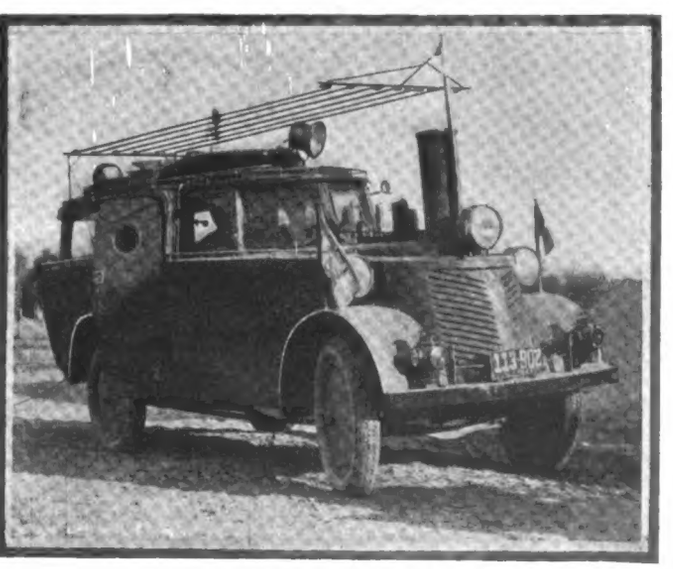
A YACHTING trip across the continent from Jamestown, N. Y., to Los Angeles, California, has just been completed in a four-and-a-half-ton steam-driven craft which is now cruising over the desert wastes and through the mountain fastnesses of Southern California from its home port of Palm Springs in Riverside County.

"Captain" C. S. Abbott, owner and commander of the unique land-going yacht, conceived the idea of building a boat body on the chasis of a powerful, well-known make of steam automobile and equipping the craft with all the conveniences of yachting. Captain Abbott is a mechanical engineer with the means to complete successfully anything

(*Continued on page 307*)



Side View of Radio Equipped "Land-Going" Yacht.



The "Land-Going" Yacht Under Way.

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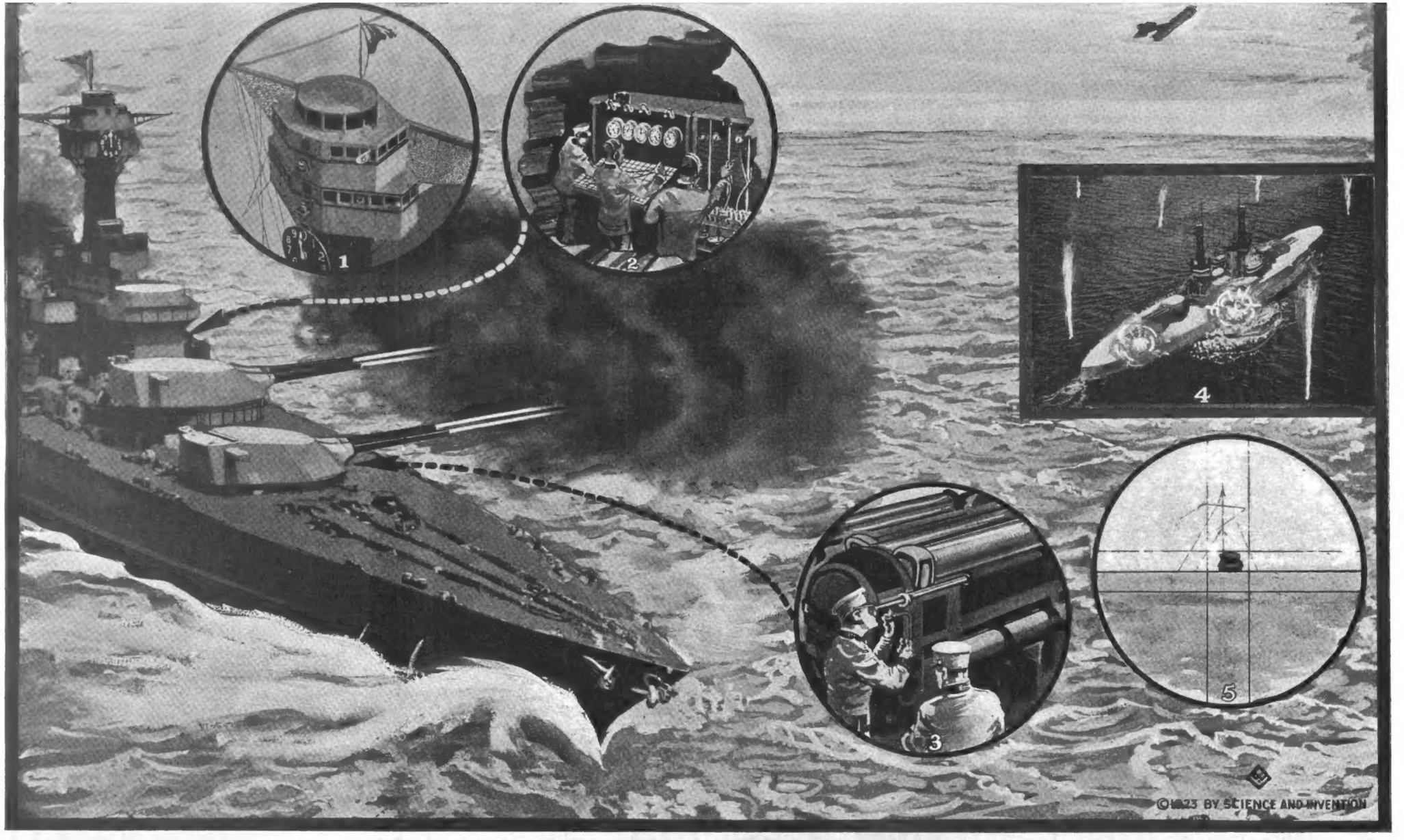

HOW ENEMY TARGETS OVER THE HORIZON ARE SPOTTED AND HIT BY NAVAL GUNNERS.

It Has Long Been a Mystery to Landlubbers as to How the Naval Gunners Can Fire at a Target Over the Horizon and Hit Their Mark. Mathematics Plus Radio, Plus Airplanes, Give Us the Answer. The Vessel or Fleet Doing the Firing, Send Out a Scout Plane to Spot the Enemy, and Also the Location of the Shots, Whether They Fall Short of the Target or Beyond It. The Spotter in the Plane Radios Back to the Ship the Results of the Shots, and in a Few Moments the Range Has Been Corrected, and as Shown in Fig. 4, Some of the Shells Begin to Find Their Target; This Photo Showing One Shot Short of the Target, Four Shots Beyond the Target, and Two Hits Directly on the Enemy Ship. Fig. 1 Shows the Fighting Top of a Modern Dreadnought with Range Finders and Directorscopes. Fig. 2 Shows the Chart Plotting Room Where the Range Figures Are Coordinated with the Speed of Both Ships. Fig. 3 Shows Gunner Sighting Through Telescope on 16" Gun. Fig. 5 Shows the Top of the Enemy Ship's Mast, All That Can Be Seen in the Directorscope in the Fighting Top. Fig. 5 Also Represents All That There is to Focus the Range Finders On, So That it is Thanks to the Airplane Which Flies Out Over the Enemy Target, That the Figures Are Quickly Corrected and Shells Landed on the Target.

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How Our Navy Shoots Over the Horizon

ESPECIALLY WRITTEN FOR SCIENCE AND INVENTION

By GRASER SCHORNSTHEIMER

ON a fine, clear day the ocean traveler can, with the aid of his glasses, if they are powerful enough, make out objects to a distance of eight miles at sea. Here the horizon line cuts off his vision. The curvature of the earth is responsible for this. And so it is that when naval men talk of shooting and hitting at a distance of twenty miles, many laymen indulge in amazement and a few seem to think that they have read about such things in fairy tales.

There is no question that guns can be built capable of shooting fifty or even seventy-five miles. The great German 8.2 inch gun, which fired on Paris, is a case in point. But everyone remembers that this weapon fired on a very large target—Paris—and that its dispersion was so great at this range that nothing of military importance was hit and its net results were only measured by its ability to scare and kill women and children.

VESSEL CAN BE HIT 20 MILES AWAY

But our naval officers have proved that it is possible to repeatedly hit so small a target as a battleship at a distance of twenty miles. Foreign navies have had similar experiences and have modernized their warships to shoot to this range. Practise has proved that 35,000 yards is a practical range for modern guns and fire-control equipment, and so every nation of importance must be able to make its guns felt at that range.

Two great fleets are out in search of one another with the object of destroying their enemy. The scouting screens of cruisers and destroyers are out with a few scattered submarines on all sides. A submarine of the defending fleet sights an enemy cruiser and radios this news back to the commander of the defending screening forces. This commander immediately sends out a force of cruisers and destroyers to make contact with the enemy and, if possible, to break through his screen and discover his main fleet of capital ships.

The enemy sights the defenders as the attacking cruisers rush at the vessel reported by the submarine. The defending commander-in-chief has been informed of the location of the enemy cruisers and has ordered his big ships into formation with their decks cleared for action and their guns loaded.

Other points of the enemy screen are soon discovered by the defenders and all along this line the enemy is subjected to fast cruiser attacks. Finally a defending cruiser breaks through the line and followed by others it flies at top speed along a search course to discover the enemy battle fleet.

ENEMY SHIPS ARE SIGHTED

It does not have to search long before the lookouts in the crow's nest see a long line of big gray battleships stretching for miles along the horizon. They are identified as closely as possible and their disposition is certified. This information is immediately radioed back to the defending commander-in-chief, who decides to attack.

The defending commander then places a division of four or five cruisers about five miles ahead of his line and arranges his destroyers along his flanks to ward off torpedo attacks by enemy destroyers and submarines and his whole battle formation moves toward the spot from which the enemy is reported. The defenders, having the advantage of information, maneuver to a position in which they will have all the natural advantages possible.

HOW THE ENEMY COURSE AND RANGE ARE PLOTTED

Finally the defending cruisers, which have located the enemy, are sighted. The defending aircraft carriers launch their attack planes to gain the supremacy of the air and the battle is on. Finally from the fighting tops of the defending flagship comes the range—it is 35,000 yards. From the tops of the masts, the enemy fighting tops can be made out at this range on a very clear day. Immediately the big guns of the defending ship are swung around. Again comes another range—34,150 yards. It comes as before, from the range finders in the fighting tops and goes to the plotting room in the base of the heavily armored conning tower. In the plotting room an officer sits at a desk, upon which is a large sheet of cross-ruled paper. He has drawn a line across it, representing his own course; opposite one end of the line there is a dot which represents the enemy, reported as 35,000 yards away.

Now on his own course he places another dot and 34,150 yards away he places another dot for the enemy. He looks at his log and sees that he has gone 300 yards along his own course. By using these distances and angles he obtains the distance of the enemy ships, the angle at which they are approaching his own vessel and their relative speeds. He has two great clocks before him, which are built on the order of stop watches. He starts them, one to report ranges as the vessels get closer together, and the other to report the changes in range as the vessels get closer together at their relative speeds. Between these two figures he is able to figure the exact range, almost to a foot.

THE MARVELOUS EYE OF THE "DIRECTORSCOPE"

The men behind the great guns get the exact range and traverse (movement) of the vessel, which is not visible to the gunners. The same range goes back to the fighting tops and a large round instrument, with a trigger on its bottom and a telescope at its top, is sighted in the same manner as the guns. This instrument is the directorscope. It is sighted with the guns to obtain exact coincidence with their aim. The directorscope controls the triggers of every big gun on the ship. There is a little automatic telegraph in the fighting top which tells when all the guns are loaded and locked. In the telescope lens there are a set of very fine cross hairs. When the enemy target is exactly within these cross hairs, every gun on the ship bears directly on the enemy vessel and the trigger of the directorscope is pulled. A tremendous salvo roars out as the ship writhes with the shock.

ROLL OF THE SHIP UTILIZED IN SIGHTING

It is obvious that the great sixteen inch guns can not be moved to the fraction of a vertical degree to range on the enemy ship, as a rifle may be aimed by a hunter. The roll of the ship does this and all the guns move to exactly the same degree as the ship. The directorscope is able to ascertain the exact point of the roll at which all the guns bear directly on the target and at this moment the trigger is pulled.

But the directorscope can not see over the horizon to tell whether the shots have reached the target. How are the gunners to know if they have hit?

HOW GUNNERY OFFICERS "SEE OVER HORIZON"

When the ships went into action, the aircraft carriers launched their fighting planes into the air. These fighting planes have been engaging the enemy fighting planes. The firing battleship has a catapult on its quarter-deck. Just before the enemy battleships were sighted, a spotting plane was launched from it. This plane avoids the air battle and flies to a point of vantage high above the enemy battleship and safely away from its bombing area, which can be filled with bursting shell. The battle is on. Now there are six great splashes in the water. Four of them are over the ship and two a few yards short. Two shots are noted by the aviator to have hit the enemy vessel.

AIRPLANE AND RADIO DO THEIR PART

He reports back to his ship by wireless and on at least ten different wave lengths to do away with the possibility of enemy interference, "Straddle, four over, two under, two on. Dispersion so and so." This means that six shots of the salvo fired have straddled their target, that is, hit all around it, four shots have been over the vessel, two under and two have hit. He reports the dispersion, which is the distance each missing shell has fallen away from the enemy ship.

This information is received in the plotting room and again the range is sent out, together with such telephoned data as will aid the individual guns in lessening the dispersion and getting on the target. Again the little clock at the directorscope reports "ready." A steady hand is at the trigger and as the ship starts her roll, the enemy fighting tops get nearer and nearer to the center defined by the cross hairs. Finally they are exactly in the center of the field of view. The trigger is pulled and another salvo crashes out. Again comes the report from the airplane, that three of the shots have hit and that the other five are very close.

BIG GUN SALVOS EVERY 100 SECONDS

This satisfied the vessel's gunnery officer, who orders as rapid a fire as possible. Salvos crash out almost every 100 seconds. It is not long before the enemy ship has sunk below the waves or has fallen out of line badly damaged and the firing ship has been ordered to engage some other vessel.

Approximately nine tons of armor piercing shells for each salvo have been hurled through the air at the enemy vessel at a velocity of 2,800 feet a second, and this blast has been repeated almost every 100 seconds. The hits have averaged better than twenty-five per cent. And all of them have been at a range exceeding the standard maximum visibility.

The enemy ship has been returning the fire. If her guns are capable of firing to the defending vessel, she has an even chance of victory depending upon the quality of her guns, her men, her ammunition, her fire control equipment and last, but not least, her protection; the ability to resist.

If, on the other hand, she can not elevate her guns to fire to the necessary 30,000 to 35,000 yards, she might better have stayed out of action. Far better if she had stayed at port, than to have been sunk.

WHY OUR NAVAL GUNS SHOULD BE ELEVATED MORE

And the cruel fact about all this is that

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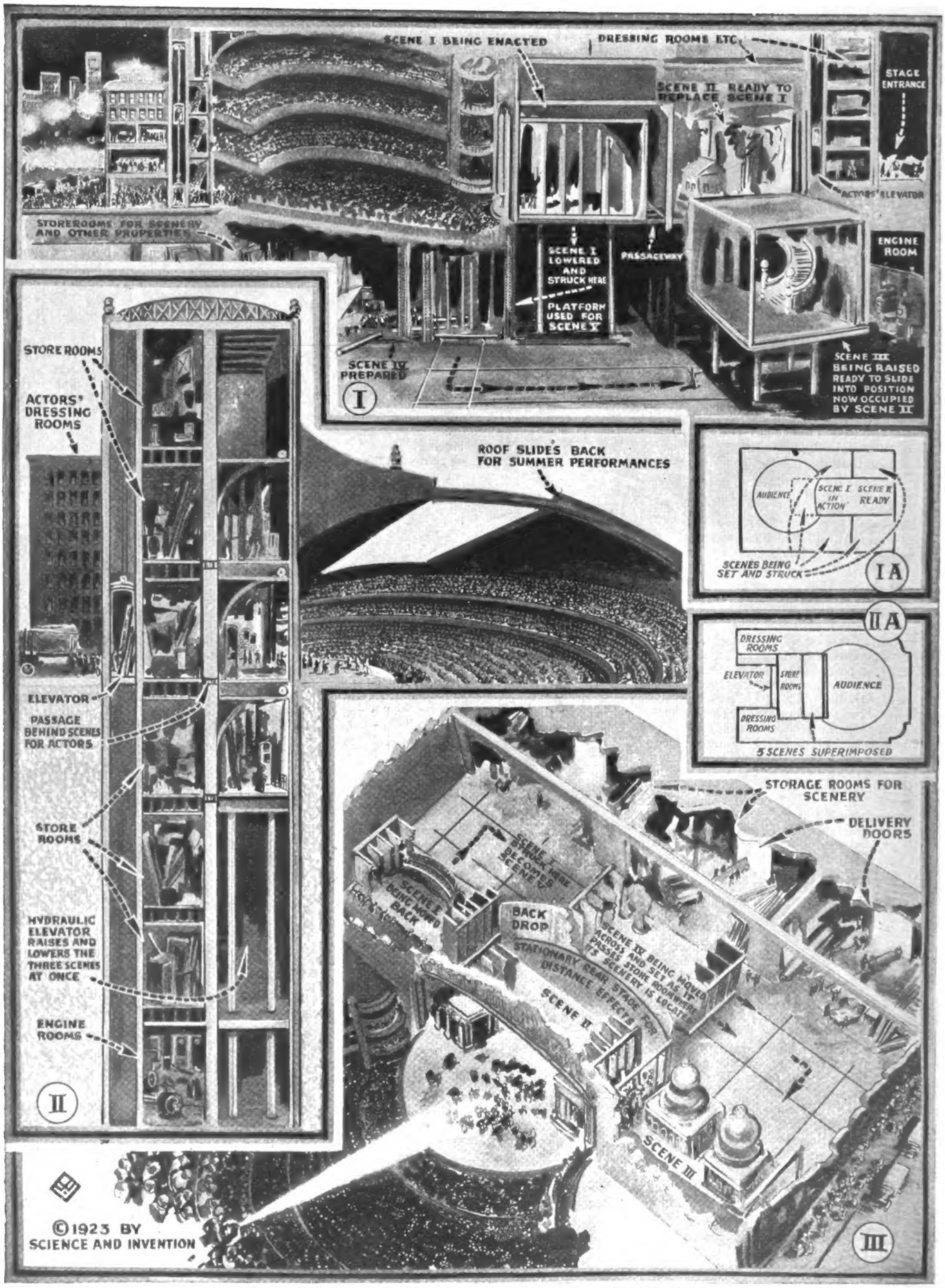

THREE PROPOSED DESIGNS FOR THE THEATRE OF TO-MORROW.

The First Design, Figs. 1 and 1-A, Utilizes Two Scene Shifting Elevators, the Scenes Being Played and Shifted One After the Other, as the Dotted Arrows Indicate. Scene 1 is Lowered and Struck (Dismantled), and Scene 4 if Used, Prepared on its Platform. Scene 2 Has Been Raised on the Second Elevator, and is Sig[illegible]ed Forward to the Proscenium Opening on to the Floor of the Elevator and Then Played. Scene 3 is Rolled on to the Platform Back of Scene [illegible] Scenes Are Shifted Around the Circuit. Figs. 2 and 2-A Show a Second Proposal for the Future Theatre, a Triple Stage Being Mount[illegible]vator, Either of the Three Stages Being Set with Scenery from One of the Various Scene Storage Rooms, the Latter Being Served by an [illegible]treet Side. Fig. 3 Shows a Third Plan in Which the Three Scenes Are Shifted from Left to Right or Vice Versa Into Position Before the Proscenium Opening, Which Latter is Changeable as to Size.

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Radical Ideas for Future Theatres

WHAT conception would you form of the ideal theatre? Such is the question which I have propounded to twenty-five eminent personalities whose answers I give here, says George G. Toudouze in *Je sais tout.*

From M. Emile Fabre the question presents two aspects; one looks to the transformation of the Comedie-Francaise, the other to the construction of a new theatre. If the Comedie-Francaise were to be transformed, it would be necessary to impose on it a long period of inaction, in order to carry out the extensive works in the way of machinery and lighting, which inactive period cannot be well submitted to and consequently necessary to limit the work to perfection of detail, such as the Gravale rotating stage.

THE IDEAS OF AN EXPERT

If it came to the construction of a new theatre, the author of the *Maison sous L'Orage* pictures to himself an auditorium containing about 1,200 seats to which the public will come more to see, than to be seen, where they will be attracted by the colors, the adornments and other features, and will find themselves face to face with a great scene lit up by projectors with a movable stage. The rotating stage presents certain advantages. The cupolas can replace the horizon and there will no longer be racks of lamps or rampes. In the opinion of the director of the Comedie-Francaise the advanced steps taken by foreigners in these matters is due to the fact that Shakespeare requires for his plays from twenty to thirty scenes for each piece, while the French theatre, based on our classics, has not striven for picturesque scenery. The foreigner is always more concerned with the exterior development of the work while France works for the soul of the piece. And again the scenery should be taken out of the hands of the artisan and should be given to the artist, who then acquires an equal title with the actor to be an interpreter of the piece and *performs* as it were, by his scenery, just as the actor performs by the rôle which he has assumed.

Mr. Jacques Rouche thinks that the rotary stage used in the Comedie theatre is less practical for the opera, intermissions between the acts being indispensable for singers; nevertheless he finds that the cupola of the Forthuny type like that of the Scala theatre of Milan presents a true superiority, especially when the illusion of sky and of night is to be carried out; but when it is lit by reflection this cupola gives a dead light without any sunlight effect. A greater danger, in case of a brilliantly lighted scene is due to the fact that the front portions will be in obscure light, with the actors appearing as dark silhouettes on a light background. It is necessary then to combine the red and reflected light with the racks of lamps and projectors and also by the use at each side scene of movable tripods carrying other projectors. In fact the manager of the Opera considers that all the systems are good and all ought to be used, but each in their place. This certainly would cost a great deal. In Milan the cupola is sometimes used only in a single act in the play and its equipment is very expensive.

GIANT ELEVATOR AND RAILS TO SHIFT SCENES

M. Antoine wants plenty of room for he thinks it is necessary to have six movable scenes interchangeable by elevators and by rails, a double system of transfer, by which each scene descends below the stage, receives its properties and rises all equipped and lighted to take position to the right, to the left or back of the scene in use, the new scene awaiting its turn. On account of these six scenes ready to be replaced from either side or from the rear, Macbeth, Julius Caesar, Faust, or Lorenzaccio, can be acted rapidly and without intermission between the acts. The rotating scene which diminishes the stage area becomes useless.

A "TRIPLE STAGE" ELEVATOR

M. Gemier proposes to divide the ideal theatre into two separate structures, the laboratory theatre and the theatre proper. The first reserved for study will be small, bare, with a single scene, without lamp racks or rampe, with hand-operated projectors, a scene on trestles, little or no properties, an auditorium of 900 seats at the service of a literary audience who will come to observe the actors in works involving new formulas, which may be technical, literary or social; a research theatre. The second or popular theatre, will have 3,000 seats, will present complicated apparatus, all systems of properties adapted for all kinds of plays, a stairway between stage and auditorium, sources of light hidden from the audience, musicians placed high up in the auditorium, and a system of superimposed scenery.

Three stages built upon a single elevator will rise and descend, having behind them six store rooms, in which the scene-shifters will work alternately, so as to make up the two scenes, always out of sight of the public. This is a perpendicular "coming and going," made effective by a working space at the rear. M. Gemier dreams of the resuscitation in such a theatre of national epoch, which exists no longer since Corneille and Racine evoked the national epic theatre of the ancient world.

COMPLETE SCENES MOVED ACROSS PROSCENIUM

M. Hébertot pictures a theatre of 5,000 seats, in reinforced concrete, without any decoration, with low level exits, facing a stage of considerable depth, having between an impressive proscenium and an open postscenium (back-stage) three moving stages, interchangeable from left to right and right to left. The whole would present the aspect of a cathedral whose audience would occupy the choir, whose three scenes would fill the transepts and the proscenium would be the apse. There would be no proscenium boxes nor gallery boxes. The same light would be maintained in the auditorium and on the stage. A frame for the scene, which can be extended or reduced at will, both as regards height and width, is carried out by means of sheet iron screens working in grooves. Above the audience, in a special box, the first machinist is seated before a keyboard controlling the lights which he would operate from the ceiling of the auditorium having at his side two telephones; his post of command resembling that of a ship captain. And now, what Croseus will supply the finances for one or the other of these ideal theatres of tomorrow?

America Leads in Naval Craft

WHILE still possessing the most aircraft carriers and light cruisers, the British Navy is completely outnumbered by the United States in submarines, destroyers and cruisers, according to a white paper just issued. At present the United States is also the dominant battleship power, but eight ships are to be scrapped under the Washington treaty and five more are shown as being dismantled.

The present battleship strength is: United States 31, Britain 18, Italy 12, Japan 11, France 9, Germany 8 and Russia 4. Japan is to scrap five under the treaty, leaving her effective strength at 6. The Italian Minister of Marine has power to dispose of three ships.

Britain and Japan are the only powers having battle cruisers, there being four in the British Navy and seven in the Japanese, including three which are to be scrapped. Four battle cruisers under construction for the United States are to be scrapped and two for the Japanese Navy are to be converted into aircraft carriers.

No cruiser is at present in course of construction. America possesses the greatest strength, ten in all, France ranking next with six. There are three cruisers in the Italian Navy and two in the British. Britain is supreme in the matter of light cruisers, for including six belonging to the Dominions, there are forty-eight in the British Navy and four more are being built.

Only three countries at present include aircraft carriers in their navies, the British possessing four and the United States and Japan one each, two of these vessels being built each for the British and American Navies while France is constructing one.

Great superiority in torpedo boat destroyers is held by the United States, the British being outnumbered by nearly two to one. The figures are Britain 184, United States 318. Only two navies include torpedo boats. Italy possesses seventy, while four more are being built, and Germany has fifteen. The United States is shown to possess the greatest number of submarines of any of the powers while a considerable addition is still being made.

NEW PLANE CARRIER FOR BRITISH NAVY

Every building in London with a flat roof has become a potential airdrome by reason of the invention of apparatus to facilitate the landing and taking off of airplanes from the decks of Britain's aircraft carriers.

The invention will enable every navy of the future to put to sea with not only a vast number of airplanes, flying boats and seaplanes, but its own airdromes and workshops, say English air experts.

In the new type of aircraft carrier there are two decks connected by huge lifts. The upper is the airdrome deck, and the lower is equipped with workshops for carrying out repairs. There are also supplies of necessary spare parts, ranging from a propeller to a complete engine, all ready for instant use.

The flying deck is fitted with a searchlight and landing-light tower, which make it possible for a machine to land at night. There are also cranes for hoisting on board flying boats which need repair.

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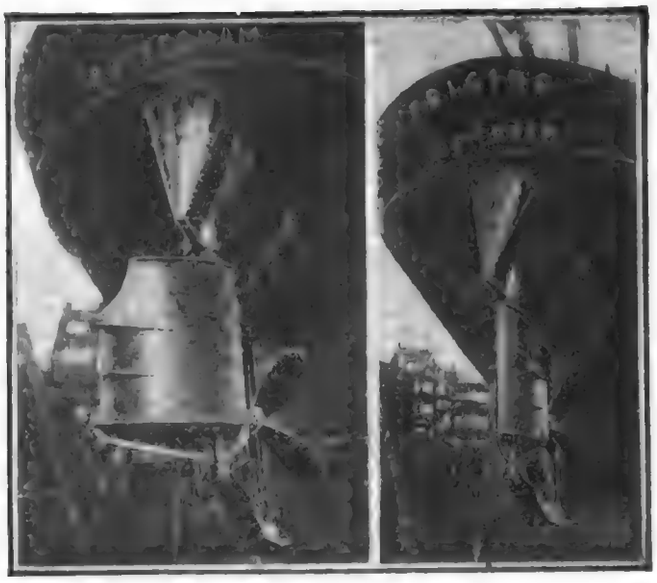
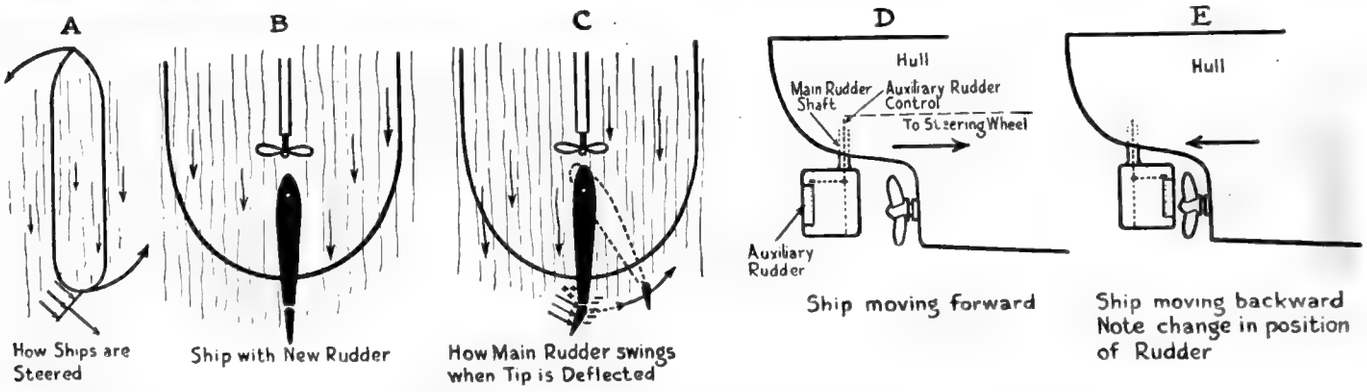


Engineless Rudder for Ships

NOVEL RUDDER FIRST STEERS ITSELF, THEN CHANGES COURSE OF SHIP

By DR. H. BECHER

The Flettner Rudder Here Shown Installed On Two Steamships Is a Remarkably Clever Invention. It Enables a Ship To Be Steered By the Forces In the Swirling Waters As the Ship Moves Along, and Requires No Engine Power For Turning the Rudder. The Speed of Turning, As Well As the Force of Rotation, Is Proportional To the Speed of the Vessel In Relation to the Water Through Which It Is Traveling. The Rudder Is Mounted So As To Be Free To Rotate On Its Axis. A Small Movable Tip On the Rudder Is Turned By the Pilot Through Suitable Cables, and the Resulting Reaction of the Swirling Water Against the Rudder (See Fig. C) Causes the Main Rudder To Swing To Right Or Left, Depending Upon the Direction In Which the Tip Was Moved. Figs. D and E, Below, Show Side View of New Engineless Rudder Set For Ship To Move Forward, and Also For Ship To Move Backward.



AN invention which promises to eclipse everything in the line of ships' rudders, and which may even cause a complete revolution in the construction of the rudders of both ocean-going and coastwise vessels, has recently created a sensation among marine experts and specialists. It was invented in Germany by Mr. Flettner.

Everyone is undoubtedly familiar with the processes employed in the steering of a vessel. In the pilot's cabin one generally finds a large wheel. This wheel in very small vessels communicates directly with the rudder which is thus controlled manually, and in stormy weather two men are generally found at the steering wheel or helm. In steam steering gear there is generally a subsidiary smaller wheel, which is used to do the steering. When turned it admits steam to the steering engine. Then the engine starts into action, turning the rudder through a greater or less angle, according to the turns given the steering wheel, and while doing this by special gear it automatically and gradually closes its own throttle valve. Thus the deflection of the rudder is limited by the action of the steering engine on its own steam supply. In other words, the steam engine acts as a follow up, and will swing the massive rudder in either direction until the correct position is assumed. This steering engine requires the expenditure of quite a lot of power in the form of steam. Naturally it occupies space, and it further increases, although but to a slight extent, the weight of a ship. The necessity of the additional amount of steam causes a further consumption of coal by the furnaces of the vessel.

In the Flettner rudder, however, all of these inconveniences are done away with. The latter swings the rudder instead of falling back on the steam engine adapted to the purpose, is developed by the swirling masses of water. The action of the water actually turns the rudder in this new invention. The speed of turning as well as the force of rotation, is proportional to the speed of the vessel in relation to the water through which it is traveling.

This rudder is mounted in such a manner that it is free to rotate on its axis. As will be seen above, the rudder has a streamline effect, being thicker in the center and tapering at either end. On close observation one will perceive that a small auxiliary rudder is attached to the end of the larger rudder, and it is this auxiliary rudder which actually effects the steering operation. The illustrations above will show exactly how the rudder operates.

Suppose that the end of the auxiliary rudder is twined to the left, as illustrated in Fig. C; it will be observed that the action of the water against this little tip will cause the large rudder to turn over to the position indicated by the dotted lines, which position the rudder will hold until the tip is straightened again, whereupon the rudder will be brought back to its original straight position. This auxiliary rudder is manually operated. The ordinary method of swinging the entire rudder is shown in the small illustration, Fig. A.

Not only will this new rudder operate when the ship is moving forward, but when the ship is reversed, the action of the auxiliary rudder on the main rudder reverses, and then steering is accomplished in the usual manner. This view is shown in the photograph, Fig. E. The turning of the rudder backward is automatically accomplished. This is further illustrated in the diagram. The main rudder is hollow, being braced throughout.

It is claimed that steadiness of course of the ship is possible by employing this system, due to the fact that fluctuations resulting from the swelling of the sea and pitching of the ship, are easily compensated for, these conditions requiring formerly a surplus of attention at both steering wheel and steering engine.

The photographs which we show of the Holland steamer *Frigido* on which the first actual tests were made. So remarkable were the results obtained with this ship, that in consequence of its performance on the high seas, the Hamburg-American Line has decided to equip the eight thousand ton motor ship *Odenwald* with the Flettner rudder, and the North American Lloyd line will use the new rudder on a nine thousand, three hundred ton freight steamer. The high economy of power calculated to be about 95 to 98 per cent in connection with this rudder, resulting in eliminating the steering machine plant, is only one of its novel features. It may be mentioned in passing, that the tip of the rudder is comparable to the wing tips of an airplane, known as the ailerons.

$10,000.00 Challenge

For authentic proof of the production of ectoplasm or spirit manifestations. Do not fail to read this remarkable challenge to all spiritualists, mediums and "ouija specialists" in the August number of Science and Invention. Remember! $10,000.00 challenge. Open to everybody.

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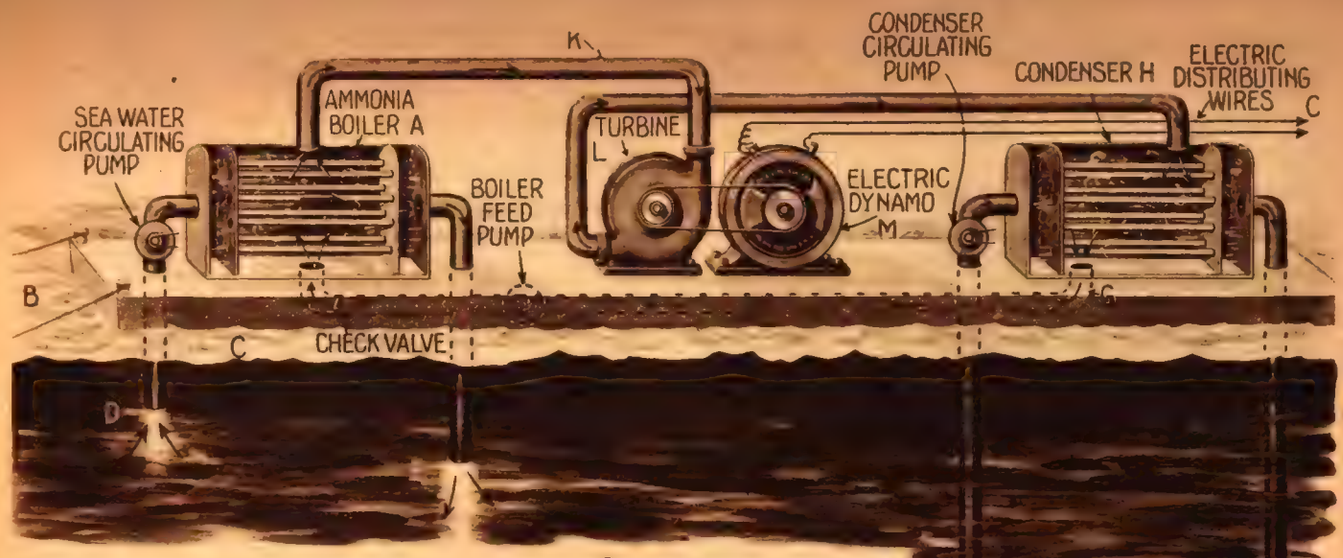

Electricity from Sea Water

THE Italian papers for some time have been speaking of a sensational invention which is attributed to a certain Signor Boggia, and which is supposed to be destined to furnish immense quantities of energy at a very low price. Professor Dornig, who has collaborated effectively in his work with Signor Boggia, has given a lecture in Milan before the Engineers' Society, which gives a certain authority to the ideas which we are going to express here.

He treats in short of a new way of directly utilizing solar energy which the earth receives from the rays of our great luminary, and which is really enormous. Professor Dornig estimates that the earth receives thus each year on the average at least one hundred thousand times more energy than that which could be developed from the coal extracted from the bowels of the earth during the same period.

The various attempts made up to the present time, including that of Archimedes, of utilizing the solar energy directly by means of converging mirrors or otherwise, has the great defect of being very expensive. The enormous amount of energy at our disposal being realized, it follows that it is better economy to sacrifice efficiency of utilization to reduction in the capitalization costs for the installation of the plant. For this reason our inventor prefers to collect the solar energy at a low temperature, rather than to try to raise the temperature by means of the methods alluded to above.

Has the Means Been Found at Last for Utilizing the Enormous Reserve Power Which Emanates from the Sun? The Curious Project Which is Described Here, and Which is Due to Two Italian Investigators Has the Double Merit of Scientific Precision and of the Picturesque. The General Arrangement of the Boiler and of the Turbine for Utilizing Solar Heat is Here Illustrated. A, Ammonia Boiler; B, Sea Level; C, Warm Water; D, Tube Taking from the Surface of the Sea the Warm Water Which Passes Through the Boiler; E, Exhaust Pipe for Warm Water; F, Vertical Pipe Fifty Feet in Diameter, Drawing Water from a Depth of Three Hundred and Fifty Fathoms for Passing it Through the Condenser; G, Tube Carrying the Ammoniacal Vapor into the Condenser; H, Condenser Liquefying the Ammoniacal Vapor; K, Tube Conducting the Ammoniacal Vapor from the Boiler to the Turbine; L, Turbine; M, Electric Generator; N, Vertical Tube One Hundred and Fifty Fathoms in Length, Returning to the Lower Level of the Ocean the Water which has Cooled the Condenser; O, Cables Carrying the Electric Power to Factories Situated on the Shore.

THE LARGEST BOILER IN THE WORLD

For this purpose, he proposes to construct a gigantic boiler, which without fear of contradiction can be called the largest boiler in the world. To make it more intelligible, we think it will be useful to put into a few words the principles of the boiler and of the steam motor.

A standard form of boiler is a large metallic vessel closed, and containing water which is submitted to the action of heat liberated in a fire. The water is thus converted into vapor, which is used in one of the two following methods. This vapor can be sent into a reciprocating machine, comprising a cylinder, in which under the action of the steam pressure, a piston receives a reciprocating motion back and forth through the said cylinder; or the steam can be sent into a turbine consisting of a drum with wings or paddles; the steam acts by its speed on these wings and turns the drum. The reciprocating engine or the turbine may for example, drive an electric generator or a dynamo.

But what becomes of the steam as it leaves one of the other of these machines through the exhaust? It can be exhausted directly into the open air, but more often it is passed through a condenser, which is a recipient of sheet iron generally cylindrical in shape, with a certain number of tubes through which a current of cold water is driven by a pump. On contact with these cold tubes the steam liquifies and falls to the lower part of the condenser, whence it is returned to the boiler. The use of the condenser affords not only the advantage of saving the fresh water necessary for boilers—an important point in the case of ships in particular—but also permits a much higher efficiency of the system.

It is a group of machines of this kind which the inventor proposes to bring together, entirely for the utilization of solar heat.

ELECTRICITY FROM TROPICAL SEA WATER

The best conditions for utilizing this heat according to the inventor, are found in the tropical seas where the temperature of the upper layers of the ocean are constant all through the year, in the neighborhood of 25° C. (77° F.), while at a few hundred yards

(*Continued on page 297*)

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Around the Universe

An Astronomical Comedy

By RAY CUMMINGS

The Space Flyer on its Way

THIS is the first installment of our great scientific novel, "Around the Universe," which will run serially in SCIENCE AND INVENTION *for the next six months.*

Mr. Ray Cummings is a well known scientific writer of great ability who has several scientific novels to his credit. Mr. Cummings not only is a good story writer, but a scientific genius as well. In this serial, Mr. Cummings is bringing out astronomical facts of interest to everybody, in such a way that even a child can understand what it is all about. If astronomy and the theory of relativity is not clear to you, this story will surely explain it in a language that everyone can readily grasp.

—EDITOR.

CHAPTER I

IN WHICH TUBBY BECOMES AWARE OF HIS WONDERFUL GIFT, AND ACCOMPANIED BY SIR ISAAC SWIFT DeFOE WELLS-VERNE, STARTS FOR VENUS.

"THAT ain't so," Tubby spoke up suddenly from the seclusion of his seat across the room. He glanced at the three men who sat around the little table under the circle of light, their poker game temporarily suspended, the cards and chips pushed to one side. "That ain't so nohow. Don't you tell *me* it is!"

"He ain't tellin' *you*," responded one of the men caustically.

"I ain't sayin' what *I* think," the first man defended. "I'm tellin' you what *he* said. The Stars goes right on past the Sun—right to the edge of Space—only there ain't no edge of Space. *That's* what he said."

"You're right, Jake," agreed the second man. "That's what he said."

Tubby glared belligerently, and brought his pudgy fist down upon the flimsy arm of the camp chair into which he was wedged. "That ain't so. There must be an edge to Space," he snorted. "How can Space go on forever? That ain't got no sense to it."

The first man continued patiently:

"*He* said if you could imagine the edge of Space with nothin' on beyond, that would just be more Space, wouldn't it?"

This question addressed directly to Tubby, confused him momentarily. The place where Space stopped with nothing on beyond! Sure that would just be more Space. Then, quite suddenly, the flaw in the argument struck him.

"You got the wrong idea," he declared condescendingly. "*I* ain't never said there was nothin' on beyond the edge of Space."

"He's right, Jake," the second man put in. "He ain't never said that."

The first man stared.

"You're assumin' somethin' you ain't got no right to assume," Tubby went on mercilessly.

(*Continued on Page 282*)

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"What's That?" He Asked, Amazed. "I Ain't Never Seen Nothin' Like That in the Sky Before. Is That Where We're Goin' To? We Must Be Almost There Now. What Is It? Venus?" "That's the Earth," Said Sir Isaac Calmly. "We Have Turned Over, You See, Because Our Base Is Heavier. We Are Now Diagonally Away from the Earth, Partly Toward the Moon and Partly Toward the Sun. I Shall Head Directly for the Sun Later To-Night."

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"He carried her to the window, and, carefully holding his precious burden, began the perilous descent. Fortunately the leader-pipe was strong; it stood the double burden it had to bear. The heroic animal reached the ground in safety."

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 18
The Secret of the Talking Ape

[*Author's Note. Parrots can be taught to utter a few phrases, but their intelligence is too limited to admit of their understanding much, if anything, of what they say. Dogs have considerable intelligence, but lack the proper vocal organs for speech. Apes, however, especially such species as the orang and the chimpanzee, possess vocal organs similar to those of man, and have an intelligence probably superior to that of a dog. There would seem no reason, therefore, why an intelligent ape of one of these species might not be taught to understand and to speak a few simple sentences. It is an experiment that would be well worth trying, and I have outlined here the method to be followed in giving such instruction. There is a trained ape on exhibition here in Vienna now, who performs the exhibition tricks mentioned in the story, and in addition has four distinct cries, any one of which he makes at the command of his trainer. The story, therefore, has a good basis of fact.*]

"WELL, doctor," cried Silas Rockett gaily, as he burst into Doctor Hackensaw's private office one fine Spring morning, "What new marvel have you got to show me today? I suppose some day you will be learning to understand the language of animals."

"Perhaps so," replied Doctor Hackensaw, smiling, "but at present I am engaged in the opposite task—I am teaching an animal to understand human language."

"I thought most domestic animals did that to a certain extent already. A dog, for example, understands a great deal of what is said to him."

"True, though the understanding is much less than most people are apt to imagine. When we witness the performance of trained dogs at a vaudeville show, we are too ready to believe that the dog understands the rôle it is playing; when, as a rule, the dog is merely repeating mechanically a series of actions that have been taught it, and yet that mean nothing to it. But today I am going to show you something that has never been attempted before. Some years ago, with the greatest misgivings, I undertook the task of teaching an ape to speak. I have succeeded beyond my wildest hopes, and today I am going to introduce you to Chimp, my talking ape!"

"What do you mean?"

AN APE THAT CAN TALK

"I mean what I say. I am going to show you an ape that can talk and can understand when spoken to. True, its vocabulary is limited, but it compares favorably with that of some savage tribes, who are said to use only about three hundred words."

Silas Rockett looked puzzled. "I don't understand you, doctor," said he. "Of course I know that most animals have a language of their own. A dog can bark, howl, yelp, whine, groan, bay, growl, snarl, etc., and another dog will understand him. I know, too, that Professor Garnier believed the chatter of monkeys to be a real language, and he even attempted to learn it. Do I understand that you succeeded where he failed, and that you are able to understand the chatter of monkeys?"

"No," replied Doctor Hackensaw, laughing; "I haven't mastered the monkey language, yet, and I very much doubt if it is any more extensive than that of a dog. To the best of my belief it is our stupid domestic barnyard chicken that has the largest vocabulary of any animal. A chicken understands about twenty-seven distinct cries made by other chickens. These cries are really sentences. Every one is familiar with the 'Cock-a-doodle-doo!' of the rooster; the 'Cut-cut-cut-cut-cut-cuddah!' of the hen;

(*Continued on page 298*)

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Blasting the East River Over the Subways Connecting New York and Brooklyn—an Engineering Job Carried on Without Tying Up Traffic in the Under River Subway Tubes, and Without Any Outward Display of Water Geysers or Flying Debris. This Work is Carried on with a Drill Boat and a Dredge Boat, as Shown. After the Holes Have Been Drilled in the Rock Thirty Feet Below the Water, an Explosive Was Loaded Into Each of the Holes and Suitable Electric Cap Wires Attached. These Wires Lead Up to a Blasting Machine on the Deck of the Drill Boat, and the Man in Charge of the Blasting Signals to a Lookout on Shore, When Everything is Ready to Make a Blast. The Man on Shore Then Communicates with the Subway Train Dispatcher, and at the Moment When There Are No Trains Passing Through the Under River Tubes, He Telephones This Information to the Man on the Pier, Who Dips a Red Flag. At That Moment the Blaster on the Drill Boat Pushes the Button and a Series of Charges in the Rock Below Are Detonated.

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Blasting River Bottom Over Subways

THOUSANDS of people who travel back and forth under the East River between New York City and Brooklyn daily probably never know that solid rock is being blasted from the river bottom to a level thirty-five feet above the subway tubes. Before exploding the first blast in this great engineering work, which is being carried on for the purpose of deepening the East River channel in order to enable the large warships to find a free passage to the Brooklyn Navy Yard at all tides, a careful test was made by experts who went down into the Clark street tunnel. It is said that as the first charge of explosive was detonated in the rocky river bottom only thirty-five feet above the tube, the surface of a glass of water placed on the floor of the tube shook ever so slightly, and thus provided reassuring evidence that the work could be carried on over the tubes without undue danger. The rock is not literally blown out of the river, which would, of course, be liable to cause too severe a shock to the subway tubes, but as Mr. Charles D. Pullen, vice-president of the dredging company carrying on this work, said: "We push the rock apart. We do not attempt to blow the reef up. The charge cracks the reef. Then the dipper goes down and lifts the boulders chipped off from the parent rock up into the scow. When filled, the scow is towed away, and that's really all there is to it, except that it takes a lot of planning, a lot of figuring and a lot of money."

TWO SUBWAYS TO CONJURE WITH

There are two subway systems connecting the lower end of Manhattan Island with Brooklyn; one of them is known as the Brooklyn Rapid Transit or Montague Street tunnel, through which trains roar back and forth day and night between Whitehall street, Manhattan, and Court street, Brooklyn; while the second under-river tube system is called the Clark Street tunnel, which is maintained by the Interborough Company. The old East River channel afforded about thirty feet of water, but with the advent of larger and heavier ships, it has become necessary to provide a wider and deeper channel with about forty feet depth of free waterway. As the accompanying illustration shows, this necessitated the removal of about ten feet of solid bed rock along the channel, leaving an average of thirty-five feet of solid rock above the subway tubes.

The big handicap to making the tunnel deeper is Diamond Reef, which is an exceedingly hard rock formation jutting up in the river bed. Thus this job of deepening the channel to a forty-foot depth involves what amounts to under-water rock-quarrying, with the added complication that considerable rock must be excavated directly over the subway tubes, and this engineering project is considered one of the most difficult and involved problems which has presented itself in recent years.

$10,000 Challenge

To spiritists and mediums for authentic proof of the production of ectoplasm, materializations or ouija board demonstrations. Open to everybody. Don't miss it—you may be the lucky person!.

AUGUST FEATURE ARTICLES IN SCIENCE AND INVENTION

SCIENTIFIC PARADOXES—ILLUSTRATED,
By Edward M. Weyer, Jr.

THE AUTOMATIC THEATRE ORCHESTRA OF TOMORROW, By H. Gernsback.

PRACTICAL NOTES ON REFLEX AMPLIFIER CONSTRUCTION,
By Robert E. Lacault.

TANTALUM—THE STORY OF THE FIRST CHEMICALLY PURE TANTALUM AND ITS USES IN ELECTRICITY AND MECHANICS, By O. Ivan Lee.

AROUND THE UNIVERSE—SECOND INSTALLMENT,
By Ray Cummings.

THE ROLE OF COMPRESSED AIR IN MODERN SUBWAY PRACTICE,
By Richard H. Tingley.

HOW I BUILT MY FIRST RADIO SET,
By Miss Dorothy Benkeser.

VARIOUS WAYS OF ENLARGING PHOTOGRAPHS,
By Dr. Ernest Bade.

HOW THE DRILL BOAT AND THE DREDGE BOAT OPERATE

The two most important factors in carrying out this work are the drill boat and the dredge boat. The drill boat is a large floating platform supporting three drill frames, a steam boiler, and a superstructure housing the crew and machinery. On the drill frames about twenty feet above the water are the steam engines that operate the drills. Thirty feet below the surface of the water, these powerful drills, spaced ten feet apart, twist and bore into the solid rock to a depth of ten feet.

When the holes have been drilled and the tide is right, charges of 80 and 90 per cent du Pont gelatin are packed into lengths of galvanized iron leader pipe and lowered into the holes. It is then but a moment's work to connect the wires leading to the charges with the electric blasting machine. The drill boat moves away about seventy-five to one hundred feet riding on her anchor chains, and the preparatory work is done.

The shot firer, who is aboard the drill boat, takes up his station, and turns his eyes shoreward. He signals that he is ready, and an inspector on the pier raises a red flag indicating that he has seen the signal, and that his assistant is telephoning the Brooklyn Rapid Transit Subway train dispatcher. The telephone wire remains open, as the dispatcher watches the green signal lights flickering across the chart before him which represents the tunnel system. Each train as it moves through the tube is indicated on the chart board by a light flash, which moves progressively along as the trains pass the block signals. He holds up other trains from entering the tunnel, and as the last green light fades, indicating that the tunnel is cleared of all trains, he gives the word by telephone to the inspector's assistant.

FIRING THE BLAST CHARGE

The red flag drops, the shot-firer aboard the drill boat sees the signal, and pushes down on the handle of his blasting machine, sending an electric current through the wires to the charges of gelatin explosive in the holes in the rock below, and the force of one hundred pounds of dynamite is released.

Forty feet below, the rock has been shattered, but there is so little disturbance of the water at the surface that unless someone pointed out to you a circle of foam surging up from the bottom of the river, it would most probably escape your attention. It is gone a few seconds later. The subway trains are rushing through the tunnels again within ten seconds after the charges have been fired, while the dredge boat with its powerful scoop machinery gobbles up the crushed rock fragments on the river bottom and deposits them on large scows. The drill boat in the meantime is back on the job drilling another row of holes.

It is the intention of the Government engineers eventually to dredge a channel forty feet in depth at mean low water, about one thousand feet wide and one mile in total length, extending from deep water in the upper bay opposite Governor's Island, to deep water in the East River beyond the reef at Old Slip. This total area when finally blasted and dredged out will require, no doubt, several years' work before being finished, but this same quantity of rock will not have to be excavated over this entire area as the water in some places is deeper than in others.

Advertise World's Needs

The British Institute of Patentees has started a "What's Wanted" book, in which Sir William Bell offers his suggestions as to inventions needed by the world. The list includes:

Glass that will bend.

A smooth road surface that will not be slippery in wet weather.

A furnace that will conserve 95 per cent of its heat.

A process to make flannel unshrinkable.

A noiseless airplane and an airplane that can be managed safely and easily by a boy or girl.

A motor engine of one pound weight per horsepower.

Methods to reduce friction.

Practical ways of utilizing the tides.

A process to extract sulphur from vulcanized India rubber, so that it can be, so to speak, boiled up and used again.

A pipe that can be cleaned easily and effectively.

A temperance drink that will keep and yet not pall on the palate.

Talking moving pictures.

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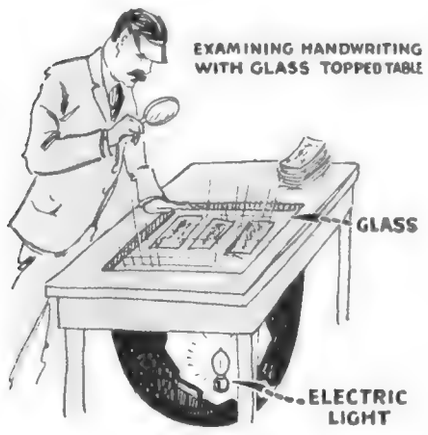
Scientific Tools of Modern Detectives

By FERI FELIX WEISS

(*Concluded*)

NEXT he searched among the wreckage which had piled up in the cellar. He found the remains of a brass bedstead melted into big lumps of metal. As an expert chemist he knew that the heat of a fire resulting from the burning of a wooden frame house



A Glass Top Table Provided With a Strong Electric Light and Suitable Reflector Beneath Is Frequently Found Valuable For Examining Hand Writing, Forged Checks, Etc.

and furniture could not be of sufficient intensity to melt this metal. These two facts led him to the conclusion that a powerful chemical agent must have been added to the blaze to produce a terrific white heat. Chemical analysis of the ashes revealed this agent. He also found a tiny piece of fuse which had been soaked in kerosene on a charred part of the staircase which, by a miracle, had not been destroyed, and the microscopical and chemical analysis showed that part of the fuse led down into the cellar where it no doubt had started the blaze—a blaze which not only set fire to the house, but melted the brass bedstead and scorched trees a long distance away.

It was thus proven beyond the slightest doubt that: (1) the fire was not accidental, as the husband contended; (2) it might have been set twenty-four hours previous to its actual occurrence, with premeditated murderous intent, or after he had killed his wife; and (3) he could still prove an alibi of being fifty miles from the place of his crime on the day the fire raged.

The chemist, and especially the *explosives expert chemist*, is the pivotal point around which anarchistic, black-hand or other bomb explosions or safe blow-ups circulate. He can, by a few pieces picked up here and there in the debris, tell, as a rule, what has caused the explosion: dynamite, TNT, nitroglycerine or what not; how powerful was the charge; from which angle worked; how exploded; what means (mechanical contrivance) was used to explode the charge; how long a time may have elapsed before the time bomb went off, and so show how much time the perpetrators of the outrage had in which to make a get-away, and many other things.

It is he who is called in when the detectives find a bomb which experience teaches them to "handle with care!" In Milwaukee, on one occasion, the neglect of a detective who opened a suspicious-looking parcel, brought to headquarters by a woman, to dip it first in water, or better, to call in the expert, caused the instantaneous death of sixteen officials.

The expert in fire-arms, formerly called the "gunsmith," tells how recently the gun was fired, what was its make, what caliber munition was used, with what speed the bullet traveled, how the gun was manipulated, and many points which are all a closed book to the layman or juryman.

And the expert on *poisons* testifies as to whether the murdered man or woman was killed by a vegetable or mineral poison, by a fluid or gas, how quickly it affected the victim, how it worked, and in what part of the anatomy.

Biology is of use in the detection of crime. Professor Hans Gross, the great European criminologist, is authority for the statement that he can tell from a hair under a microscope whether it is from the head of a man or a woman; even how old (approximately) is the person whose hair is under observation—if the roots are dipped in a solution of caustic potash they will dissolve and the younger the person, the more rapidly will the process take place.

The biologist also makes blood tests to decide whether blood stains are those of human beings or animals; and in cases of questionable paternity he is often called upon to decide the race and color of the child.

It has been shown how the *surgeon* and *anatomist* play a part in the great dramas of the court.

Not every detective, of course, can be expected to have a knowledge of these highly technical subjects, but he must know in what branch of science to seek aid, he must have some intelligent idea of the things the scientists will look for and of what facts may be expected from him. The detective or lawyer, who is not in touch with these sciences to some slight degree at least, misses a good many clues and loses a good many cases from lack of evidence.

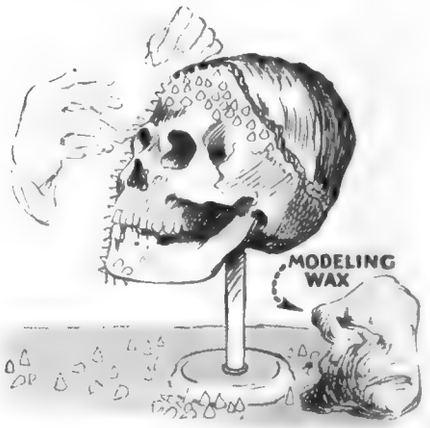
It is safe for me to state that but one detective in every ten has ever heard of *face plastic*—yet it has brought about some striking results.

FACE PLASTIC

This science is founded on the theory that each bone in the human body has a special set of muscles and special kind of skin covering it, and what these are may be determined from certain characteristics of the bone. Thus the body may literally be reconstructed from a bare skeleton.

Not long before the war a human skull and other bones were found in a forest in Bohemia when the snow melted in the spring. Apparently the body had been lying there all winter. Inquiry in the neighborhood about missing persons led to no identification of the body. The skull was taken to a scientific criminologist in Vienna, who rebuilt it by putting on tiny wax cones with the pointed ends up, creating a wax foundation over the bones, which, when covered with smooth wax and some other coating and painted with lifelike tints, resembled most strikingly the man it used to be, especially as a few remaining strands of hair showed the scientist the color of the deceased's hair and gave a clue to the complexion.

An Ultra-Scientific Application To Detective Work Lies In the Suggested Use of Eye-Glasses Containing Dicyanin Dye, Which Enables One To See Human Figures In the Dark, Due To the Aura Surrounding the Body.



"Face Plastic," the New Art of Modeling a Face From Wax Over a Skull Suspected Or Known To Be That of the Victim. The Wax Cones Are Placed Over the Face To Give the Height of the Flesh Or Contour, and Afterward These Are Covered With Smooth Wax, and the Face Then Painted. Hair Is Placed On the Head, and Many Confessions Are Obtained With This Built Up Evidence.

This head was then photographed and the picture sent to police offices all over the land, with the result that a letter came from the chief of a small village in which he stated that the son of a wealthy nobleman had disappeared the previous fall, and that no trace of him had been found until the appearance of this photograph resembling him. The professor made a trip to the castle of the nobleman and the father recognized in the wax head the likeness to his son, as did others in the family.

As the skull had shown an axe cut, it was evident that the young man had met with foul play. How to find the murderer was the next problem, and, if found, how to make him confess!

It seems that the murdered man had been on an errand to collect a large sum of money the day of his disappearance. He had been driven to town by a sulky peasant. This peasant had been under suspicion from the first, but he had insisted that the young man had gone into the bank in town, and had then told him to wait at a certain trysting place to which he had never come. He insinuated that the young man had probably taken the money and gone to America or to sea, as he was fond of traveling and had had a quarrel with his father sometime previous on account of his roving disposition.

The following stratagem was resorted to. The young man's rebuilt life-like wax head was placed on his skeleton dressed in clothes he used to wear when at home. Next his body was propped up just as if he were alive in his favorite chair at the table. Then the peasant was sent for.

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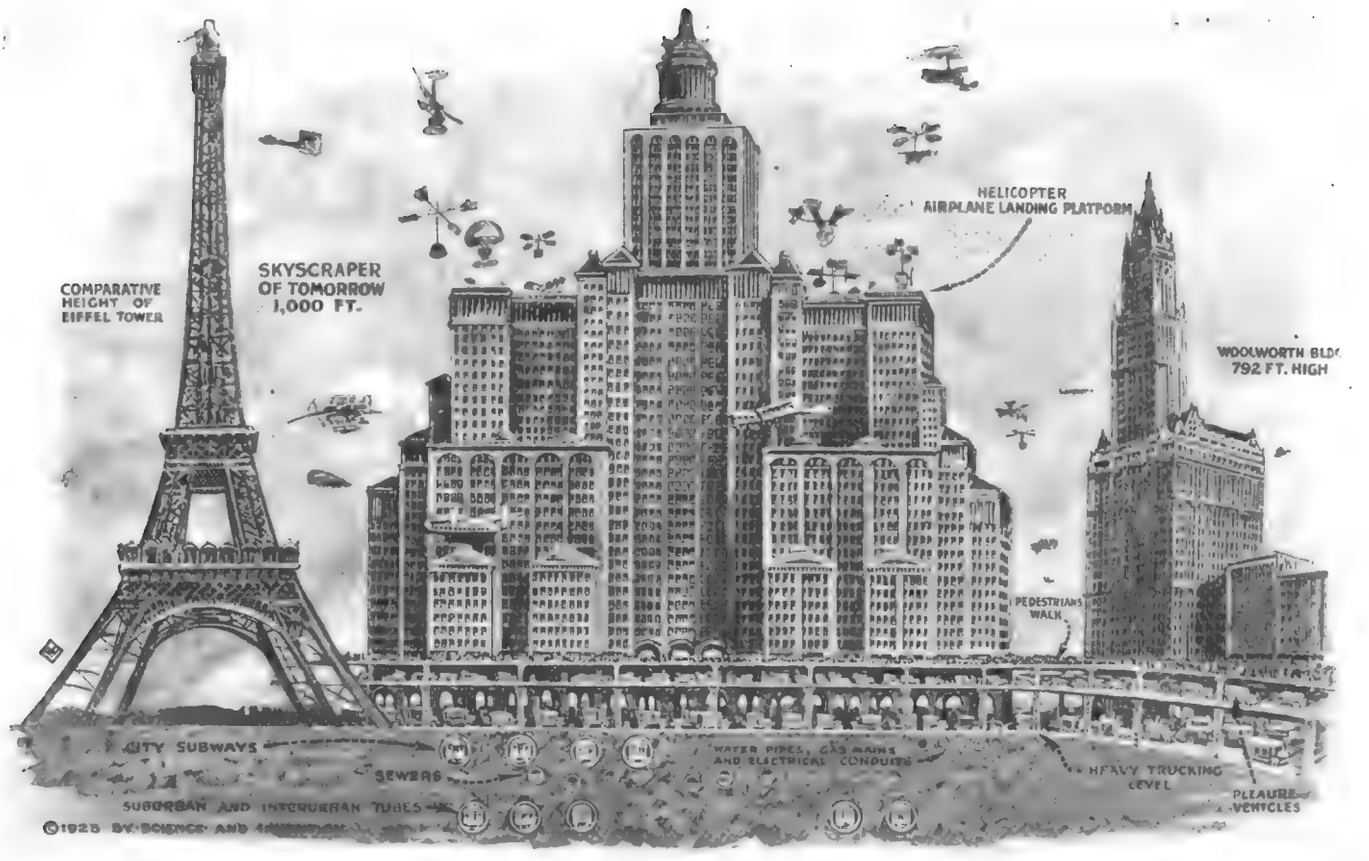

The Skyscraper of To-morrow Shown in the Drawing Above, Will Tower Upward to a Height of One Thousand Feet, There Being Sixty Stories in the Building. The Traffic Will Pass Right Through Tunnel-like Passageways in the Building, and There Will Be at Least Three Levels for Traffic Above the Ground. Ample Provision Will Be Made for the Future Mode of Rapid Locomotion by Airplanes and Helicopters.

Skyscrapers of To-morrow

By H. WINFIELD SECOR

THE tallest office buildings of today are exemplified by such magnificent monuments of the architects' and engineers' skill as the Woolworth and other similar buildings erected in the larger American cities. The highest of these buildings is the Woolworth edifice, which towers 792 feet skyward, with its fifty-one stories of offices. The skyscraper of to-morrow will probably not exceed one thousand feet in height, as above this figure they become a decided menace in heavy winds or due to other causes, such as earthquakes, etc. A New York architect and engineer, Mr. Harvey W. Corbett, President of the Architectural League of New York, has designed a new skyscraper of the future which soars upward sixty stories, to a height of one thousand feet, and covering a large city block, such as those extending between the avenues in New York City, or about four hundred feet square. Mr. Corbett believes that these new structures, which will come into being probably within the next fifteen to twenty-five years, will combine business offices together with a hotel and apartment house system; and he bases these ideas on the belief that New York will grow more and more to be the great central business center of the world.

ADVENT OF THE SET-BACK SKYSCRAPER

The skyscrapers of the future, believes this architect, will take the form shown in the accompanying picture, with set-back roofs.

The future skyscraper, as outlined by Mr. Arnold Brunner, President of the Fine Arts Federation of New York, embodies several interesting engineering developments, especially with regard to the handling of traffic on the streets surrounding such great buildings. New York at present is a city of two levels, one on the surface, and one underground. No doubt in the future we will have at least three levels of traffic; one underground, that on the surface, and another above the surface. The underground arteries of traffic will comprise subways, under-river tubes, etc.

Motor trucks and other heavy vehicles will have possession of the street or ground level with passageways through arches built under the large buildings, while an elevated roadway above the street level proper, will accommodate pleasure vehicles and pedestrian traffic.

A suggested solution of the traffic problem is shown in the accompanying illustration, drawn by Mr. Wardell, wherein the pedestrian traffic takes place along walks possibly twelve feet or more in width, supported on brackets or otherwise against the building walls. It is easy enough to design schemes for providing different levels of traffic, as those here outlined and pictured, but it must be remembered that the engineers behind the government of our larger cities have been striving steadily to eliminate elevated structures of the type which tend to darken the streets below.

No doubt before a great while we will be provided with some newer form of cheap and strong transparent material, resembling glass, which can be used for the road-bed of such elevated roadways, so that the light will shine right through it. By keeping such roadways separated in two narrow lines passing up and down on the opposite side of the street, in a similar manner to the arrangement of the elevated railway structures in some cities now, plenty of illumination is allowed to reach the main street level between the track structures. One thing is certain, and that is, that people are not very fond of traveling in subways, but they do not have any choice in the matter, as they are provided by the engineers who lay out our cities and transportation facilities, and they are, we have to admit it seems, a necessary evil, to some extent at least. However, the editors have always had in mind that it should certainly be possible to solve some of our unbearable traffic congestion in cities by providing one or more elevated roadways, especially if care is taken to see that the street view below is not cut off almost entirely from fresh air and light.

The accompanying picture shows the proposed skyscraper of the future compared with the Eiffel Tower, which measures one thousand feet in height, and the present king of skyscrapers, the Woolworth Building, which is 792 feet in height.

LANDING AIRCRAFT ON ROOFS

On the morrow when aircraft promise to become as plentiful as mosquitoes in the summertime, there will undoubtedly be some provision made for landing planes on the roofs of buildings. To-morrow, building roofs will no doubt be found useful for aircraft landing and starting purposes, as the U. S. naval aeronautical experts have at last perfected the catapult for projecting the planes into the air at the rate of fifty miles an hour, and a remarkable net described several issues ago, whereby an airplane can be stopped within a short space. With the development of the helicopter, which is just now starting to come into prominence, the airplane of to-morrow can be made to rise straight up or down.

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Above in Photo No. 1 We Have an Illustration of a Typical Poison Ivy Leaf. Poison Ivy is Found in Nature in Two Forms. The First is a Small Shrub, and the Second is a Climbing Vine. The Real Poison Ivy, and the Shrubs Produce the Same Poisonous Effects and Eruption.

Photo No. 2 Shows the Flowers of a Poison Ivy Vine. This Vine Secretes a Resinous Substance Which Clinging to the Skin, Produces an Eruption. In Photo No. 3 a View of a Poison Oak Plant is Given.

Treatment of Poison Ivy and Insect Bites

By DR. ERNEST BADE

ALONG the woodland paths there is a cooling shade, the hot sun plays fitfully through the leafy crowns of the trees, on every hand there is an exhilarating odor of growing things. Viburnum and smilax are on either side together with elderberries and brambles. But there is also the poison oak, a bush like shrub, from knee to waist high. It appears to be a harmless looking growth but its effect upon the skin when touched is known to all who have had ivy poisoning.

Of poison ivy there are two kinds which are not commonly distinguished from each other. Both have the same effect upon the skin although one is a climbing vine and the other a smaller shrub. The real poison ivy (Rhus toxicodendron) is a climbing or trailing vine with variable three-foliated leaves which is found everywhere in open brush, ravines, and on the border of forests, although it also spreads its tendrils along woodland paths and the fences of field and meadow. As an older plant it often climbs tall trees, fastening the aerial rootlets upon its rough bark. The other species, known as poison oak, (Rhus radican) is smaller, more shrublike, having thicker and more elliptical and less lobed leaves. It is also an inhabitant of the open woodland regions and bushy hillsides, frequently covering fences with its green leaves.

Of all poisonous sumachs, for the poison ivy belongs to this large group, the poison ivy is by far the most peculiar, for, if any part of the plant is broken, a non-volatile resin is excreted which clings to the hand which bruises the growth. It is this resin which is poisonous, and, if it is unconsciously conveyed from one place to another, the poison spread and affects those parts. Even a [illegible] amount of it is sufficient to [illegible] poisoning, and within a short [illegible] w hours to two days, a peculiar itchy sensation is felt. Pustules appear which turn into blisters containing a fluid which is able to infect other parts of the skin on contact. The eruption lasts about a week. Then the skin dries up leaving no scars.

When the leaves of the poison ivy are only touched, and no cells are broken, no symptoms of poisoning will be found. It is curious to note that, while some persons are perfectly immune, others are more or less susceptible to it.

When any of this resin comes in contact with food, a grave internal poisoning will result. This may become so serious, that a nervous disease or paralysis may develop.

The poison of the poison ivy is never transmitted through the agency of the wind—all beliefs and assertions to the contrary notwithstanding. The poison is *not* volatile, is *not* found on the hairs of leaves *nor* is it present in the pollen, and *therefore* it is a physical impossibility to transmit the poison without coming in direct contact with it.

The resinous substance given off by the poison ivy when the cells of the plant are broken, is known as toxicodendrol. This active principle is insoluble in water, therefore simply washing the affected part with soap and water has no effect, and if its removal is attempted with fat or oil, it will soon be found that the poison has spread still more. On the other hand toxicodendrol is easily removed with alcohol, and speedy and permanent relief is obtained by washing the affected part frequently with a solution of 50% to 75% alcohol to which sufficient powdered acetate of lead (sugar of lead) is added until no more will easily dissolve. This will effectually prevent the poison from spreading. If alcohol is not at hand, then table salt may be used, first wetting the skin and then powdering it well with salt.

(*Continued on page* 294)

REMEDIES FOR IVY POISONING

1—Iodine solution. Apply with cork or brush but not too often.

2—Sugar of lead solution. Apply with cotton or a piece of cloth—don't use for more than a day or two or it is liable to cause lead poisoning.

3—Household ammonia. Apply about once an hour with cotton or cloth. Must be fresh, strong solution.

4—Saturated sal-ammoniac solution; harmless, and can be applied as often as necessary, and if desired cloth may be soaked in it and placed over the swelling.

5—Hypo-sulphite of soda, or what the photographers call "hypo"; saturated solution applied periodically with cloths or with cotton.

6—Strong salt water solution or fish brine.

7—Baking soda solution; hands rubbed with moistened baking soda several minutes after mowing lawn or picnicking in the woods.

8—Copperas or iron sulphide solution.

9—Milky sap of the milkweed plant recommended by Dr. Bade.

The author of the present article recommends that fats, oils or greasy salves should not be used, as these will cause the poison to spread still further over the skin. The poisonous element is easily removed with alcohol.

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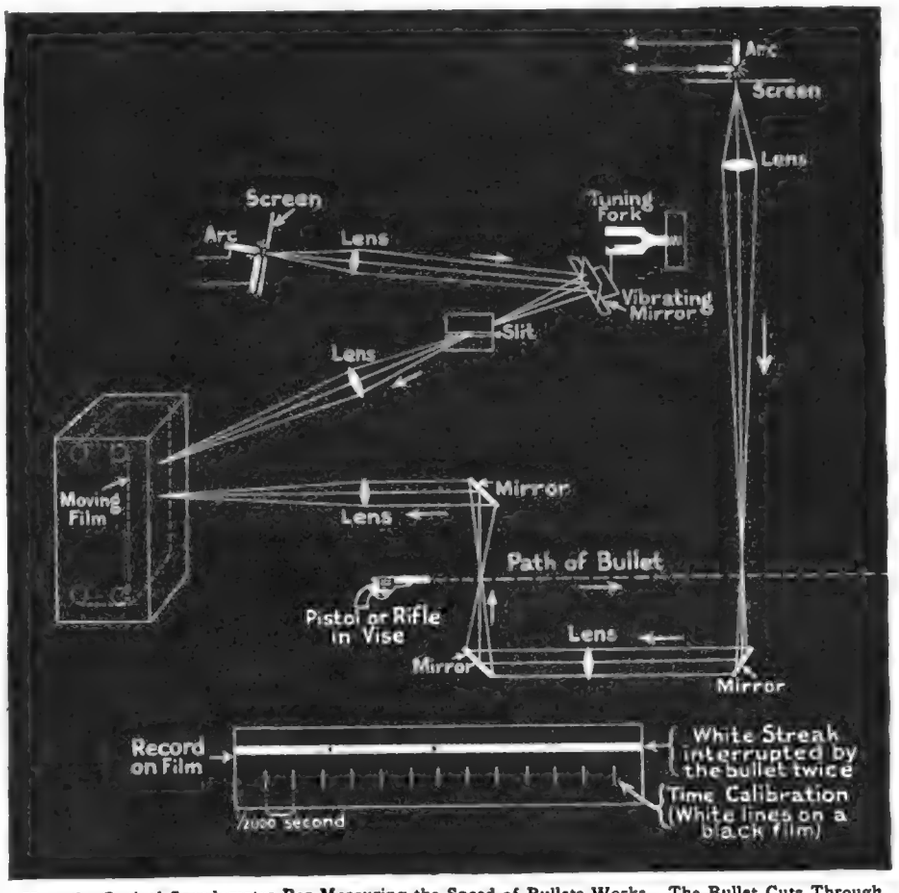
By HAROLD F. RICHARDS, Ph. D.

No. 2—An Optical Speedometer for Bullets

WHETHER his target is a gray-haired wolf or a two-legged belligerent in a foreign uniform, the chief purpose of a marksman is to hit that target from the greatest possible distance with the maximum force and accuracy. Even as late as the close of the recent war there remained in a state of incomplete solution a number of the many intricate problems which must be solved if the purpose of gunnery is adequately to be met, almost all of them involving accurate determinations of the speed with which the projectile is traveling at any given point of its path; and accordingly the efforts of ballisticians and military engineers have been directed especially towards devising a means of measuring the speed of a bullet with great precision and in a very short distance, without touching the bullet or in any way interfering with its free motion.

One who has heard a bullet whizzing past his ear at a speed of thirty miles a minute will have no difficulty in understanding that this is a problem of no mean order. Very recently, however, American research, begun during the war, has perfected two highly ingenious devices which are capable of measuring the speed of a bullet in the space of twenty inches, with an accuracy of one part in ten thousand; and the first of these methods, which is described in the present article, is further exceptional for the reason that it accomplishes its purpose without using any electrical device whatsoever. During a measurement the bullet does not touch any material substance other than air; and its speed, however great, is automatically recorded as a result of the bullet cutting in succession two beams of light.



How the Optical Speedometer For Measuring the Speed of Bullets Works. The Bullet Cuts Through the Beam of Light Twice As Seen, This Fact Being Photographed On the Moving Camera Film. It Is a Simple Matter Then To Check Up How Far Apart the Two Interruptions of the Light Beam Are, As Time Calibration Marks Are Simultaneously Photographed On the Film. In This Case the Time Marks Are 1/2000 Second Apart, and Were Made By a Tuning Fork Fastened To a Mirror.

GENERAL CONSIDERATIONS ON BULLET VELOCITY

The novel features of this remarkable speedometer can better be understood if we consider first, very briefly, the reasons why precise measurements of the speed of a projectile are essential to even a moderately satisfactory design and use of apparatus for projecting missles towards a distant target. First of all, it is of course impossible to shoot straight except in a vertical direction, no matter how excellent the gun; since there are no materials which can shield the projectile from the attraction of the earth. A bullet leaving the muzzle of a gun in a direction parallel to the earth will fall in one second exactly the same distance towards the earth as if it had been freely dropped. Thus every projectile moves along a path whose curvature, and consequently the drop of the projectile per forward foot, depends directly on the speed. Neglecting air-resistance for the moment, we may say that a 0.30 calibre bullet fired horizontally from an army rifle will drop 7.7 inches while moving forward 500 feet, and for the lower speed bullets of target automatics the drop per forward foot is proportionately greater. Thus the manufacturer of a gun must have an accurate knowledge of the speed of the bullet in order to design sights such that the gravitational drop will automatically be allowed for by the marksman.

ARMY RIFLE BULLET COULD TRAVEL 43 MILES, MINUS AIR RESISTANCE

The correction for the drop is worthless, however, if the effect of air-resistance is disregarded, and the latter factor depends even more intimately upon the speed of the bullet. The 0.30 calibre army rifle bullet would, if fired at an elevation of 45 degrees so as to have the maximum range, strike a point 43 miles from the gun if there were no air-resistance; but actually its maximum range is only slightly greater than 4 miles. In as short a distance as 300 feet, the bullet in question loses about 8.5 per cent of its speed; but the rate of loss of speed is by no means constant, since it depends on approximately the third power of the speed, and even the spin of the bullet produced by the rifling of the gun, primarily for the purpose of setting up a gyroscopic resistance to any change from a nose-on motion, exerts a further influence upon the air-resistance. This resistance also varies with the shape of the projectile and with the temperature of the air; and so far as the density of the air is concerned, the reader will recall that the long-range guns used by the Germans in bombarding Paris were pointed upwards at angles considerably greater than 45 degrees, the distance gained by causing the shell to pass through the rarer air of the upper regions proving to be more than enough to offset the loss of range resulting from firing at an angle exceeding 45 degrees. Thus, although in the absence of air-resistance all projectiles of whatever shape or size would, if fired at the same elevation with the same muzzle-velocity, travel the same distance and strike with the same speed, the results actually obtained depend so greatly upon the size, shape, spin, and speed of the bullet and upon the height of the region of air traversed, that only by measuring the speeds of different projectiles at several different points of the same flight, can sufficiently reliable data be found to permit of improvements in design and practice.

FRICTIONLESS BEAM OF LIGHT MEASURES BULLET'S VELOCITY

The optical speedometer recently perfected by Professor A. G. Webster, L. T. E. Thompson, and their colleagues, is admirably adapted to furnish the required information. Mirrors and lenses are so arranged that a narrow beam of light coming from an arc is focused twice in the path of the bullet, as shown in the diagram, at points two or three feet apart. When a bullet is not passing, this beam of light produces a continuous straight-line trace upon a moving photographic film contained within a light-proof drum; but when the bullet whose speed is to be determined is fired, it passes successively through the two foci of the single beam of light and thus produces two black spots on the photographic trace.

Knowing the distance between the two foci of light through which the bullet passes, and also the distance between the two photographs of the bullet on the film, we can

(*Continued on*

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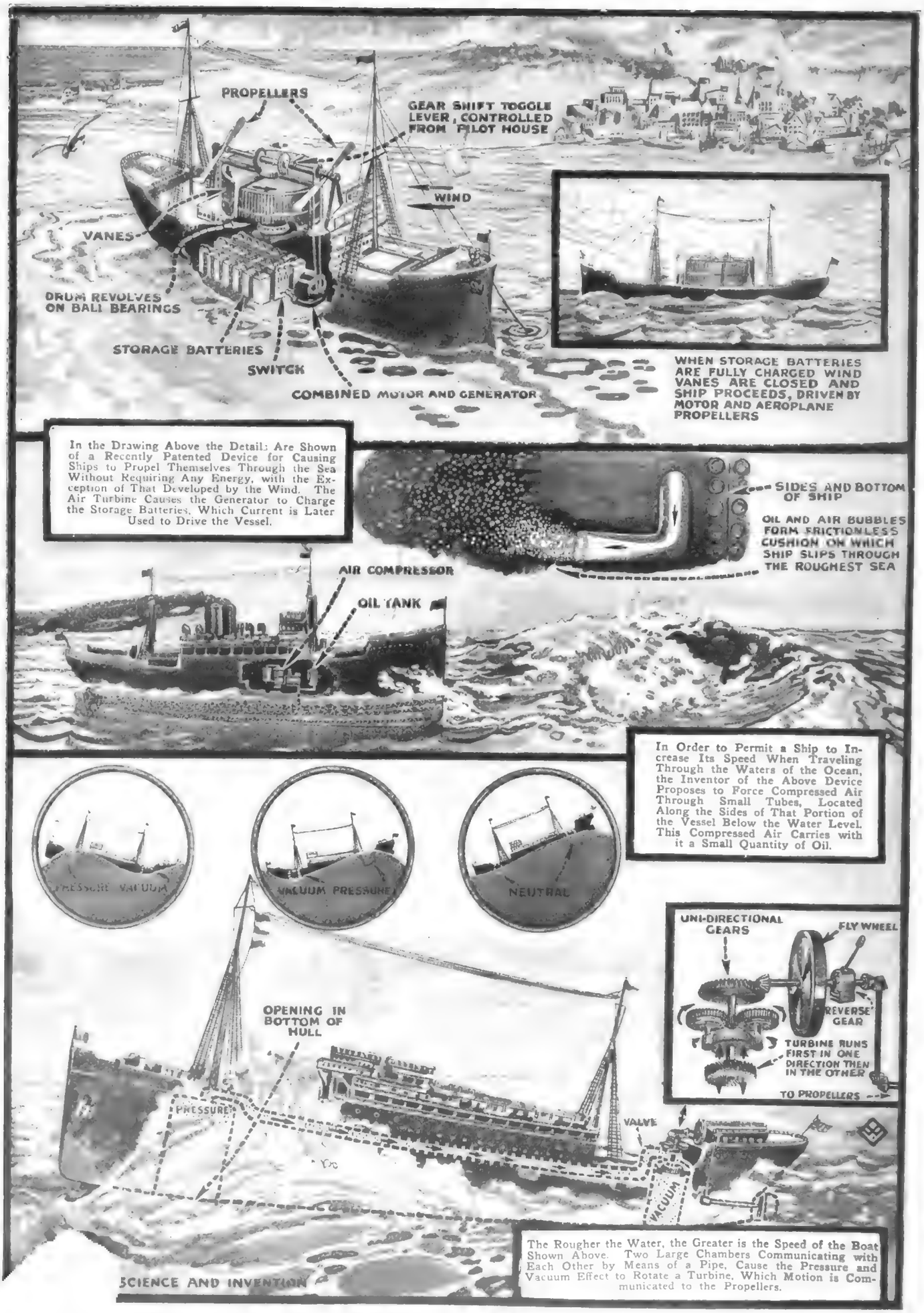
PROPELLERS
GEAR SHIFT TOGGLE LEVER, CONTROLLED FROM PILOT HOUSE
WIND
VANES
DRUM REVOLVES ON BALL BEARINGS
STORAGE BATTERIES
SWITCH
COMBINED MOTOR AND GENERATOR
WHEN STORAGE BATTERIES ARE FULLY CHARGED WIND VANES ARE CLOSED AND SHIP PROCEEDS, DRIVEN BY MOTOR AND AEROPLANE PROPELLERS
In the Drawing Above the Details Are Shown of a Recently Patented Device for Causing Ships to Propel Themselves Through the Sea Without Requiring Any Energy, with the Exception of That Developed by the Wind. The Air Turbine Causes the Generator to Charge the Storage Batteries, Which Current is Later Used to Drive the Vessel.
SIDES AND BOTTOM OF SHIP
OIL AND AIR BUBBLES FORM FRICTIONLESS CUSHION ON WHICH SHIP SLIPS THROUGH THE ROUGHEST SEA
AIR COMPRESSOR
OIL TANK
In Order to Permit a Ship to Increase Its Speed When Traveling Through the Waters of the Ocean, the Inventor of the Above Device Proposes to Force Compressed Air Through Small Tubes, Located Along the Sides of That Portion of the Vessel Below the Water Level. This Compressed Air Carries with it a Small Quantity of Oil.
PRESSURE VACUUM
VACUUM PRESSURE
NEUTRAL
UNI-DIRECTIONAL GEARS
FLY WHEEL
REVERSE GEAR
TURBINE RUNS FIRST IN ONE DIRECTION THEN IN THE OTHER
TO PROPELLERS
OPENING IN BOTTOM OF HULL
PRESSURE
VALVE
VACUUM
The Rougher the Water, the Greater is the Speed of the Boat Shown Above. Two Large Chambers Communicating with Each Other by Means of a Pipe, Cause the Pressure and Vacuum Effect to Rotate a Turbine, Which Motion is Communicated to the Propellers.
SCIENCE AND INVENTION

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Wind and Waves Drive Ships

By EDWARD H. LONDON

SHIPS THAT SAIL AGAINST WIND

SOMETIME ago the report was sent from Paris that a ship has been designed which will sail directly against the wind, and which employed no other motive power than the wind itself. This, of course, sounded interesting, but the clearest information which could be obtained of the device was that an immense propeller turned a generator, or (in another style of the design), was directly coupled with the propeller of the vessel, and as this air propeller rotated, it transmitted the motion to the submerged propeller, and consequently drove the craft ahead. In comparison with American ingenuity the French engineers, Constantine, Joessel and Daloz, have accomplished very little.

A ship serving a similar purpose was patented in July, 1922, by William P. Butusov, who hails from Norfolk, Virginia. Mr. Butusov has even gone the French engineers one step better, in that he mounts a large vertical air turbine on his vessel amidships. This air turbine operates constantly and rotates a shaft to which it is coupled by means of helical gears, but does not rotate the twin bladed propellers at either end of the shaft, which are motionless while the ship is at rest. The shaft, however, communicates by means of a belt to a dynamo, which generates current night and day charging the storage batteries. When the occupant of the vessel desires to cruise to a distant shore, he simply leaps aboard his craft, throws in the switch, closing the circuit to the dynamo, which, acting as a motor, causes the propeller shaft to revolve.

This movement would, of course, produce a motion of the turbine which is not desired. Consequently, the gears connecting the shaft with the turbine are thrown out of gear with each other, and the clutch to which the large two-bladed propellers are attached, is thrown in, causing the propellers to be revolved in unison with the shaft. We now obtain the much desired forward movement of the shaft. Of course, these twin bladed propellers could be replaced by water propellers beneath the water if desired, but if aerial propellers are employed, they can also be used to assist the vertical turbine in turning over the generator when the wind is very light.

It will be seen, therefore, that not only can the occupant of this craft sail directly against the wind, but he can sail in any other direction desired, and he does not even need to depend upon the wind. Should there be a lull in the breeze he can still continue on his cruise, and in the evening when the fresh air currents blow up and he casts his anchor, the occupant has but to engage the gears of the vertical turbine and permit his battery to be charged up over night, continuing again on his journey in the morning.

A SHIP THAT FLOATS ON AIR FILM

For increasing the speed of large ocean-going vessels, by reducing the skin friction of the vessel and the water, and for keeping the submerged portion of the hull of the vessel free of barnacles and marine growths, a Californian inventor, Timothy Joseph Mahoney, has devised a system wherein a series of nozzles project through the metal plates of the hull and turn sharply to face either toward the stern or toward the prow of the vessel. Most of the nozzles are of course, directed toward the stern. Through these compressed air is forced, which due to the fact that it passes through oil cylinders en route to its ejection nozzles, carries with it a slight amount of oil. We see, therefore, that the entire bottom of the vessel is separated from the water by a thin film of air, and that the bottom is also thoroughly lubricated. This film of air prevents the accumulation of barnacles on the bottom of the vessel, whose growth is further hampered by the oil film. The air pressure employed is just sufficient to permit of an easy flow through the nozzles, which pressure will rarely exceed forty pounds per square inch.

WAVES PROPEL THIS SHIP

An astounding arrangement for vessels at sea has been patented by two inventors from Louisiana, Edward P. Larry and Daniel J. Stein. In this device the waves themselves cause the vessel to be propelled, and the greater the waves the faster will the vessel progress.

By referring to our diagram the reader will see how this invention is to be practically applied. In the forward and aft end of the vessel are two immense cylindrical tanks, opening to the water through the bottom of the vessel. The water rises in these tanks to a distance regulated by the blow-out valve, which after the requisite amount of water has entered, namely, sufficient to enable the water within the tank to be at the same height as that surrounding the vessel, this air blow out valve is shut. In the head of one of these tanks, an air turbine may be seen. It is evident that as a wave progresses and breaks across the bow, the water level on the outside at this particular point, has considerably increased. This increase in height of the water column must necessarily be transmitted to the opening in the bottom of the vessel, which causes the air in the tank in the forward end of the vessel to be compressed and forced into the top of the rear tank. In doing so, the turbine is caused to operate. The wave then naturally proceeds to the stern of the vessel, where its motion has a similar effect on the rear tank, forcing the air in turn into the forward tank and again causing the turbine to rotate. These intermittent wave effects create intermittent motions in the turbines, which are transmitted to the propeller, the lull in the movement is taken up by the fly wheel. It will thus be seen that the vessel will move forward, depending purely on the action of the waves for its motive power, providing of course, that the power generated by this method is sufficiently great to produce a constant motion and that the plan of the inventors works out as specified. A ratchet device could be inserted on the shaft, so that the intermittent and reversing movements of the turbine would have a uni-directional effect on the propeller.

X-Rays Harmful at Distance?

HOW far X-rays extend, whether light beams harm persons subjected to their influences some distance away, has been taken up for investigation by the French Ministry of Hygiene.

Dr. Declere of the Academy of Medicine is presiding over a committee of members, which includes Mme. Curie, M. Becquerel, a radiologist; Dr. Vaillant and a number of specialists.

Suits were brought against a Paris physician by neighbors who alleged that their health had been impaired. Two cases of cancer were alleged to be due to X-rays which had penetrated through the patients and the walls of the clinic, traversed a street and passed through the wall of a dwelling house, where they affected a soldier's wife.

A leading member of the Academy said he did not believe that X-rays menaced persons who did not come into direct contact with them.

"I intend to study the question by three methods," he said. "First, we shall make a purely physical examination, studying the action of the rays and in what measure they exert themselves at certain distances. Second, we shall experiment with the living tissues of rabbits, trying various distances several hours a day and noting the effect on the red and white corpuscles and glands of the animals. Then, since it is impossible to make such experiments on human bodies, we shall collect data based on twenty-five years' experiences with X-rays to see whether physicians in close contact have been burned."

Whooping Cough Cured by X-Rays

BELIEF that the X-ray may prove of more value in the treatment of whooping cough than any other form of treatment is expressed by Dr. Henry I. Bowditch and Dr. Ralph D. Leonard in a preliminary report on their experiments to find a cure for the complaint that has baffled all treatment.

A report published in the Boston Medical and Surgical Journal says that definite improvement was noted in most of twenty-six cases of active pertussis (whooping cough) treated with the X-ray, the subjects of which ranged in age from 3 months to 40 years, with disease stages from one to ten weeks. The physicians added that they could not give any rational explanation of the action through which the X-ray appeared to produce beneficial results. The report said:

"Each patient received three or four applications of the X-ray at intervals of two to three days.

"Many of these cases have not been observed sufficiently long to determine the final result. Nevertheless, it is evident to us that there resulted a definite improvement in these patients which cannot be explained by mere accident. We cannot at this time give any rational explanation of the action through which the X-ray appears to produce the beneficial results. It does not seem likely that it is due to any direct bactericidal property of the X-ray.

"We feel warranted in classifying a small percentage of these twenty-six cases under the heading of 'prompt cures.' By this we mean that after two or three applications of the X-ray, covering a period of six days, the spasms and whoops entirely disappeared and the patients were clinically well, except for, possibly, a very slight cough.

"The bulk of the cases, however, we have classified as relieved. This group consists of perhaps 70 per cent of the total. By relieved we mean that there has been a gradual diminution in the number of spasms.

"There is a small percentage of cases, perhaps 10 to 15 per cent, which apparently were not relieved. In this group are included one moribund case and one rather difficult feeding case.

"While our evidence so far is not sufficient to warrant any definite conclusions, we have the feeling that the X-ray at the present time may be of more value in the treatment of pertussis than any other form of treatment, including serum."

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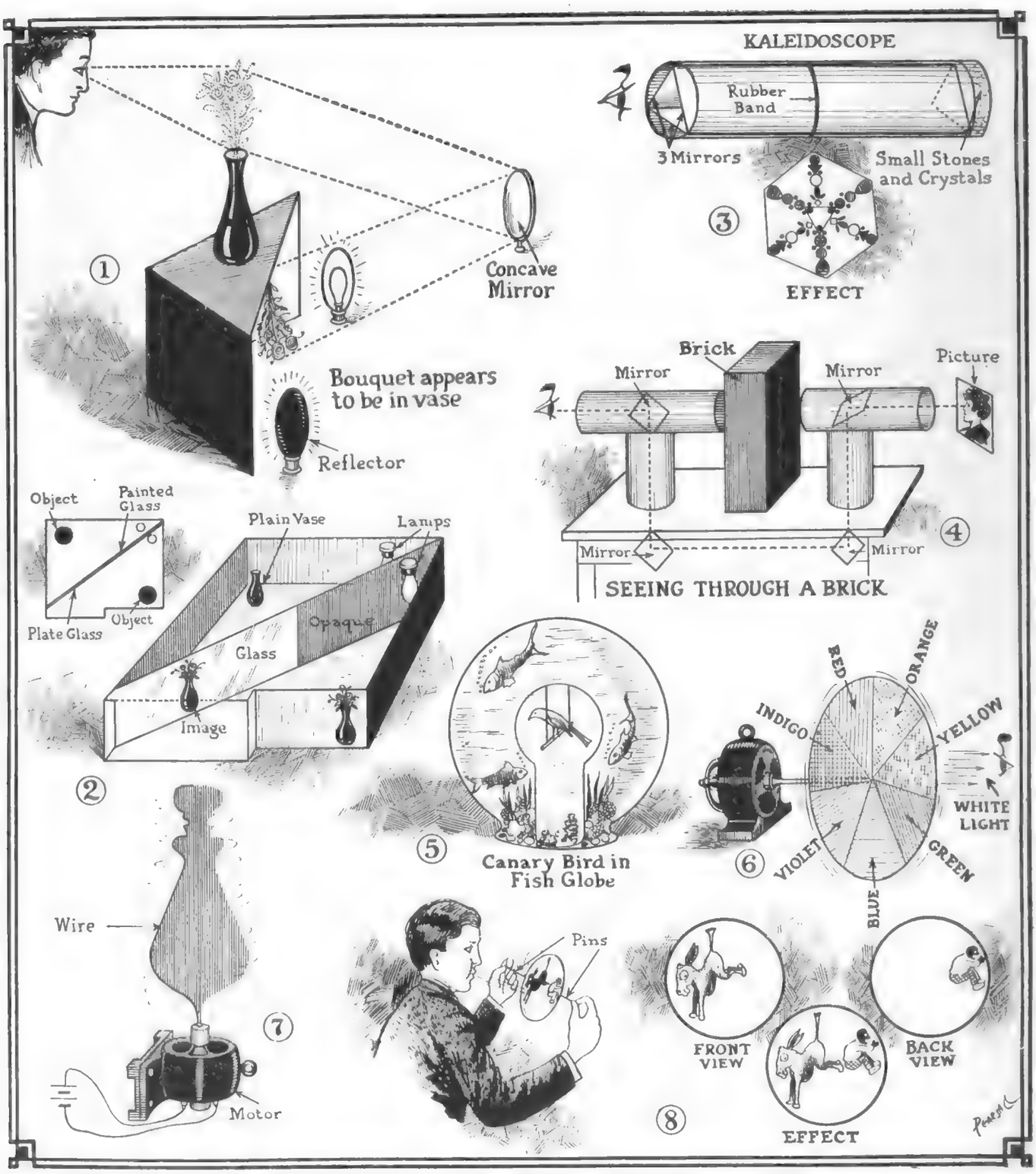

In Fig. 1 a Parabolic Mirror is Employed to Produce the Effect of a Bouquet Appearing to be in a Vase, Although Actually it is Inverted and Beneath the Stand. At 2 One Object Changes to Another Right Before the Eyes. The Optical Illusion Being Produced by the Sheet of Glass, and the Method of Lighting. The Ordinary Kaleidoscope is Shown at 3 and at 4 We Find the Method of Seeing Through a Brick by Employing Mirrors. At 5 the Canary Bird is Enjoying Himself, Watching Fish Swimming Around Him, the Double Globe Making This Effect Possible. White Light is Produced by Revolving a Colored Screen as Indicated at 6. An Ordinary Bent Wire Produces a Seemingly Solid Object if Rotated by a Motor as Indicated at 7, and at 8 the Donkey on One Side of a Disc and His Victim on the Other, Are Molded Into One Image, if the Coin is Spun Rapidly by Blowing Upon It.

"Optical Illusion Prize Contest"

IN the illustrations given above, a number of optical illusions are shown. These optical illusions are effective not only for window displays, but for parlor magic and as instructive toys for the young. In an effort to increase the number of such optical illusions now found, we are offering a contest with that end in view. The following are the terms and the conditions of the contest.

$100.00 in Prizes

First Prize—$50.00.
Second Prize—$20.00.
Third Prize—$15.00.
Fourth Prize—$10.00.
Fifth Prize—$5.00.

1. All devices may be classified under the heading of optical illusions and which will not necessitate manipulation to obtain the results may be entered. (By this we mean flip-flip movies and other forms of motion picture producers.)

2. Illustrations from books or optical illusions already printed in books are not eligible.

(*Continued on page* 291)

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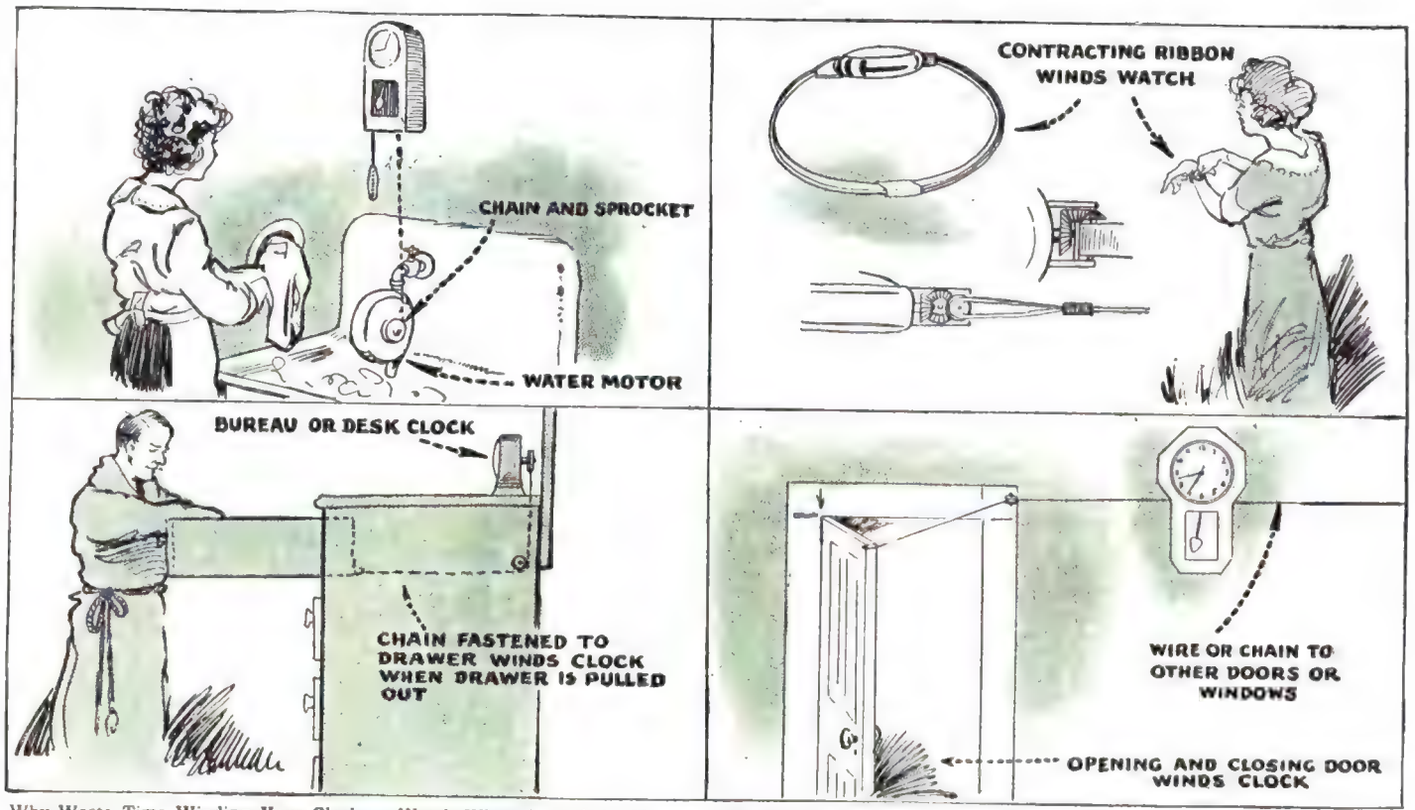
CHAIN AND SPROCKET
WATER MOTOR
CONTRACTING RIBBON WINDS WATCH
BUREAU OR DESK CLOCK
CHAIN FASTENED TO DRAWER WINDS CLOCK WHEN DRAWER IS PULLED OUT
WIRE OR CHAIN TO OTHER DOORS OR WINDOWS
OPENING AND CLOSING DOOR WINDS CLOCK

Why Waste Time Winding Your Clock or Watch When Any of the Methods Outlined Above Could Be Made to do the Work. This Prevents the Possibility of Either the Clock or Watch Overwinding. Anything That Moves Can be Employed to do the Work—Doors, Windows, Desk Drawers, Closets, or Lockers, Running Water, Bodily Movements, and in Fact Even the Wind Could Be Employed to Keep Your Timepiece Wound.

Clocks That Wind Themselves

By ISMAR GINSBERG

CLOCKS have to be wound to keep them going. Ordinary clocks are wound by hand, some once a day, others once a week, depending on the size and strength of the main spring. The ideal clock would evidently be the one that did not have to be wound up at all. But this is impossible, as the mechanism consumes energy in keeping time, and this energy has to be replaced and by winding up the spring at regular intervals However, there have been a number of very ingenious arrangements perfected whereby clocks are wound automatically, without the person, who does the work, being actually aware that he is winding the clock. The necessity of some automatic system of winding clocks is apparent in certain cases where the clocks are large and are located in inaccessible places. Furthermore, the novelty of the self-winding clock and watch is also attractive.

Inventors have been paying attention to the problem of making self-winding clocks, wherein the winding action is disguised and forms a part of other common occurrences in the household or the office. For example, quite complicated systems have been devised, in which the winding mechanism of the clock is connected with the house water supply, and the water pipes, in such a manner that when the faucet is opened and water is allowed to flow into the sink or wash-basin, the winding mechanism is actuated and the clock is wound. Clocks that are automatically wound in this fashion, generally hang on the wall, and the winding mechanism consists of the ordinary chain and sprocket wheel arrangement. The lifting of the weight, that is attached to one end of the chain, serves to wind the clock. This is accomplished by an intricate system in which the water pressure is utilized to effect the elevating of the weight. Each time that the faucet is opened the water pressure lifts the weight, the height being dependent on the time during which the water is allowed to flow. As soon as the weight reaches its maximum height and the clock is fully rewound, the next opening of the faucet operates a disconnecting device, which shuts off the winding mechanism. When the clock has been running for some time and the weight begins to reach the end of its path, the flow of water from the faucet serves to lift it once more. In this process the person who uses the water is not aware of the fact that the water is winding up the clock at the same time.

Another very popular form of self-winding device utilizes the heat of the sun's rays. Inventors are always endeavoring to make use of the tremendous quantity of energy that exists in the sun's rays. A container, made in radial form and filled with mercury, is fastened to a shaft. The light rays are concentrated on the mercury in one radial fin by the aid of a glass lens. The heat serves to cause the mercury to expand and the volume of the mercury within the radial fin is changed. This serves to change the location of the center of gravity, which result in a disturbance of the equilibrium, and the radial container is caused to rotate. This rotary motion can be transferred by suitable gearing to a star-shaped wheel. The rotating of this wheel on a shaft, to which there is also connected a small gear, meshing into the chain of the clock-winding mechanism, serves to lift the weight at the end of the chain and thereby winds the clock.

Automatic winding mechanisms, which depend for their operation on the variation in the pressure of the atmosphere or on the changes that take place in atmospheric temperature, have been devised and made to work. They are of mere scientific interest only, as the mechanism is too complicated for ordinary use.

The newest thing in self-winding time pieces is the self-winding wrist watch. This is a decided novelty and is being manufactured in England. In fastening the watch to the wrist, it is necessary, as is well-known, to adjust the ribbon, making its length longer in order to slip it over the hand and then shortening it in order to fasten the watch snugly to the wrist. The idea suggested itself to the inventor of making use of this movement of the ribbon to actuate the winding mechanism of the watch. Hence the watch is kept wound up all the time.

Wall clocks, with self-winding attachments, have been made wherein the mere opening and shutting of doors, windows or the drawers of desks, cabinets, chiffoniers, etc., are utilized to actuate the winding mechanism. Fine invisible wires are employed to connect the doors, windows, etc., with gears or other devices which mesh into the chain and lift the weight, fastened to its end. This winds the clock. The contrivance is said to be very simple and it works well, just as effectively as more complicated devices which have been used for this purpose.

Suppose that every step in your flight of stairs leading into your house or up to your apartment, were made on hinges, so that as the person walked up and down the flight of stairs, tiny air compressors would force the air through a series of pipes, thus winding up the clock, fitted with an air turbine drive. The slight cushioning effect of the stairs would be scarcely noticeable. A small weather vane fitted with a revolving wheel would keep your timepiece wound. A clock on top of a player piano could be wound by the air compressed when pumping the piano Compressed air from door checks could be similarly employed.

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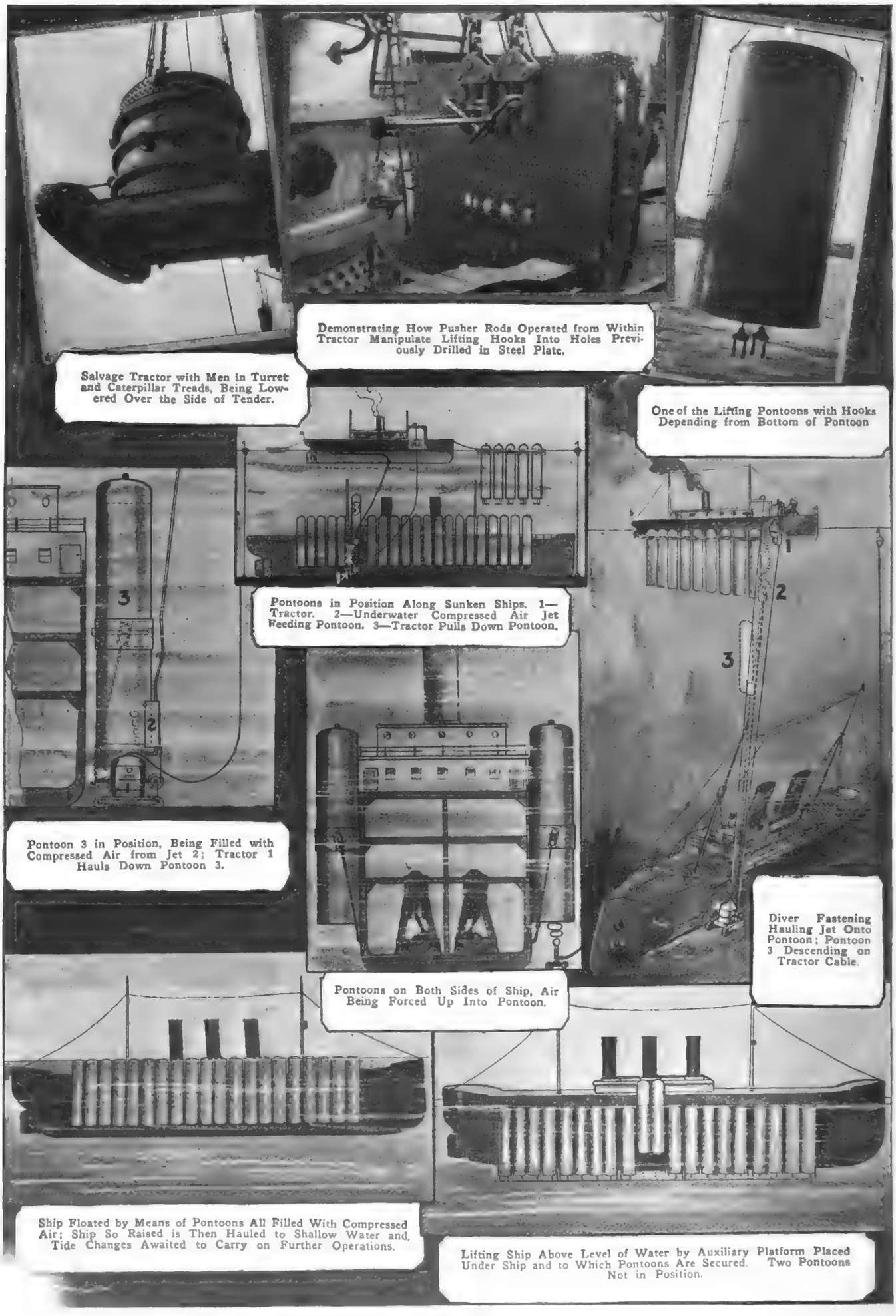
Demonstrating How Pusher Rods Operated from Within Tractor Manipulate Lifting Hooks Into Holes Previously Drilled in Steel Plate.
Salvage Tractor with Men in Turret and Caterpillar Treads, Being Lowered Over the Side of Tender.
One of the Lifting Pontoons with Hooks Depending from Bottom of Pontoon
Pontoons in Position Along Sunken Ships. 1—Tractor. 2—Underwater Compressed Air Jet Feeding Pontoon. 3—Tractor Pulls Down Pontoon.
Pontoon 3 in Position, Being Filled with Compressed Air from Jet 2; Tractor 1 Hauls Down Pontoon 3.
Diver Fastening Hauling Jet Onto Pontoon; Pontoon 3 Descending on Tractor Cable.
Pontoons on Both Sides of Ship, Air Being Forced Up Into Pontoon.
Ship Floated by Means of Pontoons All Filled With Compressed Air; Ship So Raised is Then Hauled to Shallow Water and, Tide Changes Awaited to Carry on Further Operations.
Lifting Ship Above Level of Water by Auxiliary Platform Placed Under Ship and to Which Pontoons Are Secured. Two Pontoons Not in Position.

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Submarine Tractor and Vertical Pontoons to Salvage Ships

By ERIC A. DIME

TREASURES hidden in hulks resting in the bottom of the sea have inspired inventors from times immemorial to try to originate ways and means whereby the wrecks could be raised and their valuable cargoes salvaged. The idea of salvaging sunken vessels is now receiving possibly more attention than it ever did before in marine history, and the reason for this interest is found in the immense tonnage of ships that were torpedoed and lost during the great World War.

The salvaging of wrecks in shallow water has been going on for some time, and the greatest depth from which large ships are known to have been raised is seventy-two feet. But vessels resting at depths of from 100 to 300 feet have never been brought to the surface for the reason that up to the present time there has been no efficient or practical system in use whereby the vessels could be raised. Nearly all salvaging methods applied up to the present time have involved either the attaching of cables to the hull of the ship in such number that the ship could be carried by them as her weight was overcome by means of some lifting power exerted from the surface. If the lifting was assisted by means of compressed air forced into such compartments of the vessel as could be made air-tight, the strain on the chains could be diminished by a combination of the two methods.

A step forward in submarine salvage has recently been drawn to our attention, and the system is an application of well known and well tested mechanical principles to a well understood operating situation. The inventor of this new salvage system is Jesse W. Reno, of New York, a consulting engineer and the inventor of the moving stairway or escalator.

The Reno system consists of a mobile working chamber, or *submarine tractor*, fitted for propulsion on the sea bottom by the well known caterpillar tractor belts. In addition to the tractor the system includes a series of multiple-unit, open-bottom, vertical pontoons, submerged to the depth at which the sunken vessel lies, and there securely fastened to the hull and filled with air.

When the sunken ship has been located, the tractor, or mechanical "crab," is conveyed to the scene of operations on the deck of a mother ship, or derrick lighter, which is anchored over the position of the wreck. Then the tractor, which weighs 18 tons on the surface, is lowered by means of the derrick to the bottom of the sea close to the hull. Two men form the crew of the machine and they enter the tractor through an opening at the top and the cover of this opening is screwed down tight after the men are inside. The men are supplied with air by the same system as that used on submarines. This consists in the removal of the carbon-dioxygen gas by passing the air through soda lime, and the release of the oxygen content from an oxygen tank taken down in the machine at the time it is lowered. The tractor is seven feet in diameter and nine feet high inside, and when it rests on the sea-bottom weighs only eight tons.

The tractor is driven by an electric motor within the chamber, and this motor also drives twin boring bars and an external windlass. The current for the motor and for the powerful search-lights is supplied through a cable from the mother ship, together with compressed air for filling the pontoons. Telephonic communication is provided through the power cable with no special wires. When the tractor has been lowered to the sea-bottom, the search-lights are turned on, the tractor belts are set in motion and the "crab" is maneuvered until it is brought into the right position alongside the ship.

The holes, into which the pontoon hooks are placed, are drilled by means of a combination drill and reamer-head on the end of the drill shafts. The head consists of a drill point one and one-half inches in diameter, followed up by a reamer which reams the hole to a diameter of five inches. These holes are in sets of four, or, with large ships, sets of eight. The sets of holes are located adjacent to the ribs of the ship which divide the groups at their centers. Tests have shown that a pair of holes can be drilled in four and a half minutes.

Extraordinary Tesla Experiments

To those interested in new extraordinary experiments of Tesla discharges, you will be delighted to know that a number of brand new experiments will appear, fully illustrated, in the July issue of "Practical Electrics."

Interesting Articles in July Issue Practical Electrics

ELECTRIC FOUNTAIN OF YOUTH
By Clyde J. Fitch
FORD COIL BUZZER
MY WAKEFUL BEDFELLOW
By M. McCabe
MOTOR-DRIVEN FURNACE CONTROL
ELECTRIC THREAD GAUGE
REPAIRMAN'S TEST PANEL
DETERMINING MOISTURE
By George G. McVicker
TOY MOTORS
SENDING PICTURES BY WIRE
HIGH TENSION DISCHARGE PHENOMENA
By Earl N. Holm
FARMER ELECTRIC RAILROAD

The operation next to follow is attaching the pontoons, which are made of tank steel and are closed at the top and open at the bottom. It has been figured out that pontoons twelve feet in diameter and sixty feet long are suitable for most cases, and the number of pontoons required is determined by the size of the ship. A pontoon of this size has a lifting capacity of 200 tons when filled with air. At a point slightly below the center of buoyancy, inside the pontoon, there is welded a circular truss construction, which distributes the strain of the lift to all parts of the pontoon. The attaching cables are attached to an equalizing lever, so arranged that equal strain is maintained at all times on each cable, in spite of any uneven drilling of the holes, and to compensate for any movement of the pontoons due to wave motion after the ship has been brought to the surface. At the lower end of the cables are standard crane-hooks, also mounted in pairs on equalizing levers.

Outside the tractor and at its rear is a long winding drum controlling two cables spaced eight feet apart. There is attached to these cables a hollow steel float of enough buoyancy to rise to the surface when released, carrying the cables with it. After the required number of holes have been drilled in the hull of the vessel the float is released by the men within the "crab" and the float rises to the surface. The float is fitted at the top with a hook and near the bottom of the pontoon, which is now near the surface of the water, is a staple, whose position is marked by a line of paint running to the top of the pontoon. When the float arrives at the surface a diver secures himself to it and the operators in the tractor are signaled to pull the float down. When the diver reaches the staple he inserts the hook and then rises to the surface. The workers in the chamber are notified and, starting the drum in motion, they pull the pontoon down to its position of attachment. There is maintained a sufficient amount of air in the pontoon during this operation to keep it upright. This is accomplished by means of an electric gauge, which registers the pull of the winding drum in the chamber and in the operating room of the mother ship.

The hooks are inserted in the holes in the hull of the derelict by means of an adjusting rod operated by the men in the chamber. After the hooks are inserted sufficient air is pumped into the pontoon to insure a firm grip, and to hold it in position while the other pontoons are attached in a similar manner. The pontoons are filled with air by means of a sea-bed syphon, which delivers compressed air from the mother ship to each pontoon in turn. It is obvious that care must be taken in filling the pontoons to maintain an equal distribution of strain and to insure the proper balance of the ship as it rises to the surface.

The Reno system was given a practical test this spring, when preparations were made to raise the Coast Guard Cutter *Scally*, formerly one of the Eagle boats, which lies in 60 feet of water in Long Island Sound, off Whitestone Landing, L. I. The vessel is 200 feet long, 25-foot beam and 18 feet molded depth, with a displacement rating in commission of 500 tons. Eight pontoons, each measuring 12 feet in diameter and 25 feet long, were to be fastened to the sides of the sunken vessel. There were four pontoons to each side and each pontoon had a lifting capacity of 100 tons. Six pontoons had been attached to the ship and filled with air. The other two had been attached and the work of pumping air into them had begun. Then suddenly three pontoons, one following the other at a few minutes' intervals, jerked loose from the vessel and shot up into the air.

Mr. Reno explained to the writer that the plates of the vessel were too weak to hold the strain and hence gave way for the three pontoons. The plates on the *Scally* are only 3/16 of an inch in thickness.

However, it is only a matter of working out details for securing a stronger hold on the vessel with the lifting hooks and when that is accomplished Mr. Reno hopes to raise the vessel. At the time of this writing work is progressing again on the Eagle boat, and it may be that when this article appears in print that announcement will have been made that the ship has been floated.

All parts of the Reno salvaging system operated just as the inventor had planned. The "crab" crawled over the sea bottom along the sides of the ship, to get in position when the holes were drilled; the pontoons were attached as planned for. The latter were fixed in their proper position, and had not the plates given way for the three pontoons, the chances are that the ship would have been raised. This experiment will no doubt be watched with interest on the part of those who hope to recover the treasures hidden in the ocean depths. It is claimed that this system can be used on hulls lying at depths of 500 feet.

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The Yardstick and Thermometer of American Industries

By S. R. WINTERS

HOW can the dentist determine the wear and tear on false teeth; what amount of energy is absorbed by varying types of automobile tires; can you enumerate the different kinds of rare sugars; what temperature produces the strongest brass; how thick is molasses and what is the relation of its density to its quality; and how can a business man obtain reliable information regarding the elimination of industrial waste?

No, this is not a list of conundrums for mere speculation or fictitious puzzles for fireside fancies! Rather, these were definite problems explored and partially solved by Uncle Sam's Bureau of Standards during the year 1922. Moreover, these were only a half a dozen of a total of 92,568 scientific tests completed during the last year. By classification, 62,104 helpful observations were for Federal and State Governments and 30,464 for the public.

The individual, the manufacturer, the business man, the inventor, the scientific society, the public utility corporation, and the municipality do, and may in increasing numbers, avail themselves of the services of the Bureau of Standards in solving their knotty, every-day problems. This Government bureau is capable of applying the yardstick and the thermometer to American factories and industries—with the ultimate results of eliminating waste, facilitating precision in manufacturing and obtaining high utility in products of industry by indicating an attainable standard of quality.

The Bureau of Standards classifies its functions into clearly defined divisions: Standards of measurement, standard values of constants, standards of quality, standards of mechanical performance and standards of practice. The public, however, can best visualize its capabilities and opportunities for service from a brief summary of a few of its achievements.

States and municipalities can call upon the department to compare weights and measures. Investigations of mine shale are being conducted in the coal fields of Ohio, West Virginia and Kentucky. Railroads, in 33 states, had their railroad-track scales tested, the number tested being 894. This is the greatest number examined during any one year. The Weights and Measures Section, during the past year, also agreed upon a standard temperature of 68 degrees Fahrenheit for all steel tapes. Previously this has been the standard temperature for tapes graduated in metric units only.

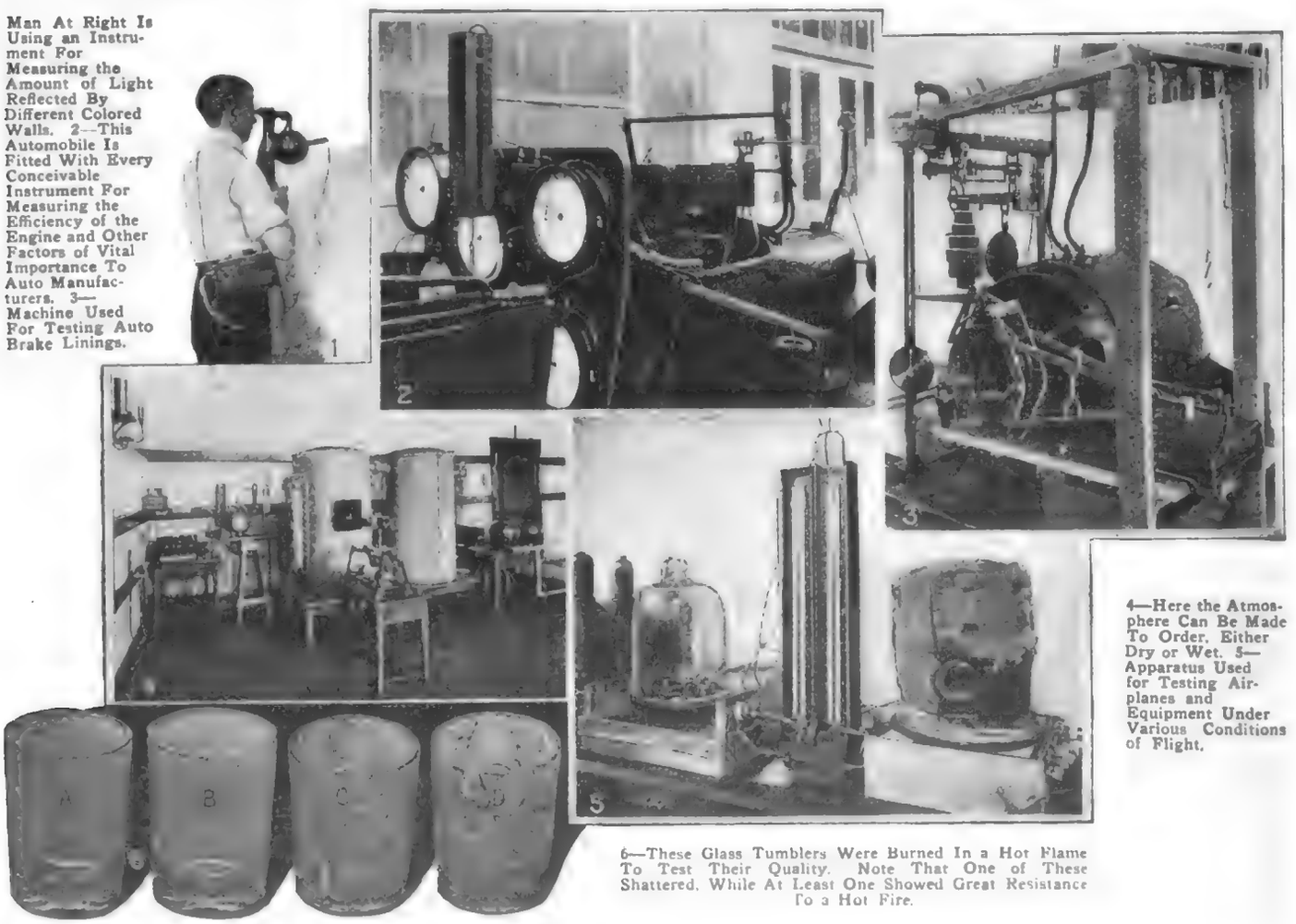
The telephone service, the bane of utility commissions and public alike, is the object of extensive investigation. During 1922, Circular No. 112, entitled "Telephone Service," was issued. This exhaustive treatise includes data relating to the design and operation of all types of telephone systems from the time Alexander Graham Bell made his discovery to the present day.

Street railways and electric lighting companies also bring their problems to Washington for solution. A three-wire power-distribution system was suggested by the Bureau and adopted by the street railway company of Wilmington, Del. The Electricity Section of the Bureau of Standards has also issued during the year a revised edition of Circular 56, "Standards for Electric Service," which, in a word, is a guide for framing regulations governing municipalities and public service commissions in connection with electric light and power service. The rules and regulations contained in this circular are in force in thirty States and in the District of Columbia.

The thermometer by which the physician determines your temperature may have been tested by the Temperature and Heat Section of the Bureau of Standards, more than 12,000 clinical thermometers having been examined at this Government bureau during 1922. The Temperature and Heat Section is concerned with researches in the field of heat and cold from the lowest point on the thermometer scale to 500 degrees Centigrade. There is a low-temperature laboratory which is concerned with the production of liquid-hydrogen and liquid-helium. Also, within the realm of temperature is the investigation being conducted to determine the relative resistance to fire of various building materials. The results of this bit of research are of concern to all builders.

The Bureau of Standards has the only *altitude laboratory* constructed in the United States. The small room, with reinforced-concrete walls, is strong enough to withstand the pressure produced on the outside

(*Continued on page* 289)



Man At Right Is Using an Instrument For Measuring the Amount of Light Reflected By Different Colored Walls. 2—This Automobile Is Fitted With Every Conceivable Instrument For Measuring the Efficiency of the Engine and Other Factors of Vital Importance To Auto Manufacturers. 3—Machine Used For Testing Auto Brake Linings.

4—Here the Atmosphere Can Be Made To Order, Either Dry or Wet. 5—Apparatus Used for Testing Airplanes and Equipment Under Various Conditions of Flight.

6—These Glass Tumblers Were Burned In a Hot Flame To Test Their Quality. Note That One of These Shattered, While At Least One Showed Great Resistance To a Hot Fire.

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Above: Phlogopite (Mica) Crystal in Gangue of Apatite and Calcite from Near Perkins, Ottawa County, Quebec. Longest Diameter, Perpendicular to Edges, 3" (7.6 cent.)

Above: Muscovite (Mica) Crystal from Black Hills, S. Dak. Size 3½" on a Side. Longest Diagonal 3¾".

The Large Center Picture Shows a Typical Mica Mine, Which is More of a Quarry in Fact Than it is a Mine, the Mica Deposits Being Located Relatively Near the Surface in Most Instances. The Mica is Lifted Out of the Pits with the Derrick and Car, Shown in the Picture. Canada, the United States and India are the Leading Producers of Mica.

Mica and Isinglass

By ISMAR GINSBERG, B. Sc., Chem. Engr.

"OH! Look at the big piece of isinglass I have found," said the small boy, as he picked up a piece of rock in his rummagings, containing a few imbedded sheets of a silvery lustrous substance. Most of us have had the same experience. It is not surprising that having originally known this substance as isinglass, the name should stick and to this day many people know mica as isinglass or else consider the two names synonomous. For what the small boy found in the rock was mica in one of its many forms.

But mica and isinglass are as different as two substances can be. They are as far apart as the antipodes in their origin, properties, appearance, commercial value and applications. Mica is a mineral found in nature, imbedded in rocks of many different kinds. Isinglass is an animal product. It consists of the dried swimming bladders of various fishes. Fish use these bladders to increase their buoyancy. The best fish isinglass comes from Russia and Hudson Bay. Brazil, the West Indies and India also furnish a supply. While various fishes are utilized as sources of supply of this substance, a certain kind of sturgeon is known to give the best isinglass. The isinglass of New York is derived from a type of cod and comes into the market in the form of ribbons. Sheet isinglass is obtained from the sturgeon.

As soon as the fish are taken, the swimming bladders are removed. Care must be taken to cleanse them of all adhering mucus and blood stains, so as to obtain a pure product. The bladders are then dried. Crude isinglass is a hard, tough substance, and before it can be used for many purposes, it is necessary to put it through the process of *cutting*. This consists of soaking the flakes until they are somewhat pliable; when edges are trimmed and the dark spots are scraped off. The product is next squeezed under high pressure between two sheets of rollers, by which process sheets of the thickness of writing paper are obtained. These sheets may then be cut into fibres of extreme fineness.

Isinglass is used for purifying and clarifying wines, beer, ale and other fermented liquors. The isinglass dissolves readily in water and when added to these beverages, it precipitates the impurities and carries them to the bottom of the tanks in which they are stored. The best qualities of isinglass are used for culinary purposes by the cook and the confectioner in the manufacture of soups, jellies, sweetmeats and other foods and confections. The same substance is used likewise in the manufacture of court-plaster and in making India inks. The textile manufacture, finds it useful in dyeing textiles and in printing calico, in imparting a high luster to silks and in stiffening linens. The poorer grades of isinglass may also be utilized in making glue for repairing glass, pottery, porcelains and in cementing leather belts and other leather goods.

Above: Phlogopite (Mica) Crystal from Sydenham, Ontario, Measuring 48" High by 34" Broad. Its Comparative Size is Shown by the Man's Figure.

Isinglass is an Animal Product and Consists of the Dried Swimming Bladders of Various Fishes. American Isinglass is Derived in Great Part from Codfish.

MICA FIRST FOUND IN INDIA

The lustrous mineral mica, found in many different colors and conditions, was first known in India. There the natives endowed it with supernatural, mysterious properties of the most extraordinary nature. It was supposed to possess magical healing powers and it was employed for medical purposes by the inhabitants of India as well as by natives of other countries in which it was found. Even the most deadly ailments were thought to yield to its influence. The early Hindu writers conceived mica to be the remains of lightning flashes, from which sparks had emanated which became preserved in the ground, as if it was fulgurites. The latter are melted rock.

At the present time India, Canada and the United States are the three principal mica producing countries.

There are many different kinds of mica. One of the main species is muscovite, which is the common mica found in granites and mica schists. Its name is derived from Russia or Muscovy, from which country it was first obtained. It is potash mica and its color is generally light—sometimes it is clear and colorless—and it has a pearly luster on cleavage.

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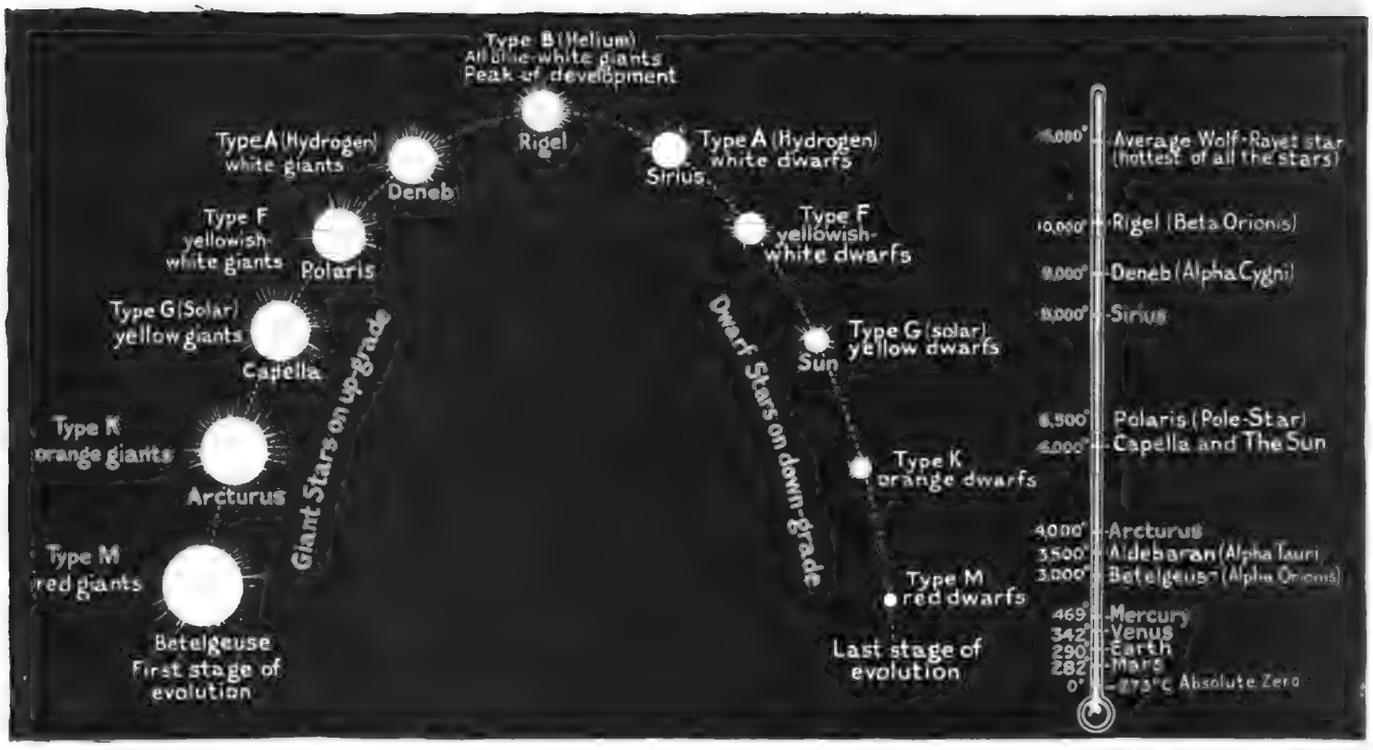

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Suns—Like People—Are Born, Pass Through Childhood, Pass Their Adolesence, and Go Down the Line Till They Die. The Above Diagram Shows Us Graphicaly How a Sun Grows Hotter As a Rule, and Does Not Stop Until It Reaches Its Apex, When It Attains a Temperature of 6,000 to 15,000° F. As It Progresses In Age, the Star Contracts and Becomes Smaller and Smaller, Until Finally It Becomes Almost Solid. It Then No Longer Gives Out Light, But Becomes Similar To What the Earth Is Today, Namely, a Non-luminous Body; In Other Words, a Dark Star. The Star Has Died.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

Of the U. S. Naval Observatory

WHEN La Place advanced his celebrated Nebular Hypothesis treating of the origin of the solar system he little dreamed that the day would come when astronomers would measure the diameters of stars that closely resemble in volume and density his hypothetical solar nebula.

The red giant star Betelgeuse, or Alpha in the constellation of Orion, has a diameter that is approximately 280 times that of our sun and a volume more than twenty million times the solar volume. If placed at the center of the solar system its surface would come within about twenty million miles of the orbit of Mars. If for Betelgeuse we substitute the fiery red Antares in the heart of the Scorpion we would have a sun nearly four hundred million miles in diameter. The surface of this star would lie some sixty million miles beyond the orbit of Mars. Mercury, Venus, The Earth, Mars and many of the asteroids would be beneath the surface of this star.

These red giants, or possibly we should say super-giants, are as tenuous as the primitive solar nebula postulated by La Place, and their surface temperatures are remarkably low as stellar temperatures go. The density of such a red giant is estimated at less than one-thousandth part of the density of air at sea-level. Compare this with the density of our own sun, which is known to be one and four-tenths times the density of water! If a man could exist at the surface of the sun he would weigh about two tons, but at the surface of Betelgeuse he would weigh at the most a few ounces.

TYPE "M" OR

Known to astron[illegible] stars.

The Life History of a Star

these red stars, of enormous volume but as tenuous as a nebula, are now generally believed to represent the first stage in the life-history of a star.

Within the past few years the heat radiations of more than one hundred stars have been measured by Dr. W. W. Coblentz of the Bureau of Standards, by means of extremely sensitive vacuum thermocouples used in conjunction with transmission screens for measuring the radiation in different parts of the spectrum. Similar measurements of stellar radiations have also been made by other scientists in this country and abroad and they have an important bearing on the theory of the evolution of the stars. In addition to furnishing astronomers with a knowledge of the surface temperatures of a large number of stars of various types, Dr. Coblentz's observations provide a means for finding the angular diameters of the same stars and, if the parallax of the star is known, the diameter expressed in miles. A check on the diameters of the three stars measured at Mt. Wilson by means of the Michelson interferometer is thus obtained and the diameters of a large number of stars have been furnished in addition. The values of the temperatures and diameters that are given in these articles are the ones based on Dr. Coblentz's work in stellar radiation.

TEMPERATURE OF RED STARS

The red giants, we have said, are believed to represent the first stage in the evolution of the stars. Their surface temperatures lie on the average between 2,500° K. and 3,000° K. The letter K indicates degrees centigrade, calculated from the absolute zero. Thus 1,000° K is equal to 727° C. They are characterized by great volume, extreme tenuity and low temperature. Such a star is considered to behave essentially as a perfect gas and as it begins to contract slowly under the gravitation of its parts its temperature rises, its volume *decreases* and its density *increases*. The long process of stellar evolution destined to consume billions of years is under way. The star is now on the *up-grade* of evolution, where it always has the characteristics of increasing density and temperature and decreasing volume. In the spectrum of a "type M" or red giant star appear the bands that are characteristic of certain refractory chemical compounds for the surface temperature is low enough to permit the formation of a few chemical compounds. The internal temperature of the star is of course much higher than its surface temperature and this is true for all types of stars. In some instances the internal temperature of the star must attain a height of many million degrees. Stars of type M have the densest atmospheres; they are very frequently variable in brightness and in one instance, that of Alpha Herculis, the star, according to Coblentz, has been known to vary in heat radiations as much as forty per cent in a single night. Moreover, series of measurements of the diameter of Betelgeuse made at Mt. Wilson with the Michelson interferometer, show marked changes in the diameter of the star within a period of a few months, changes that are clearly in excess of any possible errors of measurement. According to these

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observations the diameter of the star varied irregularly by more than *one hundred million miles* in this interval of time. It is well known that Betelgeuse is an irregularly variable star frequently changing more than a magnitude, or two and a half times, in total brightness within a year or so.

HOW TYPE "M" STARS CHANGE TO TYPE "K" STARS

Such are the red, giant stars in the first stage of stellar evolution. Gradually the spectrum of the star undergoes certain marked changes as its evolution progresses. The bands that characterize the chemical compounds existing in its atmosphere disappear and more lines of metallic elements appear in the spectrum. The color of the star now has become orange and its temperature is higher, its volume less. It is now known to astronomers as a "type K" star. In this general class we find Aldebaran, or Alpha Tauri, with a diameter of approximately 32 million miles and a temperature that averages 3,500° K. Arcturus, also, is in this class, with a diameter of 17 million miles and a surface temperature of 4,000° K.

The star continues to decrease in volume and increase in temperature and density. Its color changes from orange to yellow and its spectrum begins to show the lines that are characteristic of a "type G" or solar type star, so-called because the spectrum of the star at this stage of its evolution resembles the spectrum of our own sun, though as we will see later the sun is a dwarf star of this type and we are now considering the giants of each type on the up-grade of evolution. Among these yellow giants we find the beautiful, golden-yellow, first-magnitude star Cappella with a diameter of a little over 8 million miles, or nearly ten times that of the sun, and a temperature of 6,000° K. Its density is probably about one-hundredth that of the sun. Our star continues on the up-grade of evolution. It now becomes yellowish-white in color, hotter, more dense, smaller in volume. The metallic lines in the spectrum are yielding gradually to the lines of calcium and hydrogen, which predominate in stars of this type. In this class we find Polaris, our Pole-Star, which averages higher than 6,000° K. in temperature. As the evolution of the star progresses the lines of hydrogen begin to predominate over all other lines in the spectrum; the star is now white in color and is known as a "type A" or hydrogen star. Such a star is Alpha Cygni, or Deneb, with a surface temperature of 9,000° K. In this class also we find the magnificent Vega, in Lyra, that shines so resplendently in the evening skies in summer and fall evenings, and which has a surface temperature of 8,000° K. Our giant star is now approaching the peak of its development, attained only by the most massive stars. Its white color becomes tinged with blue; instead of hydrogen we find that helium now predominates over all other lines in its spectrum. Its temperature rises to 10,000° K. or over. It is now a "Type B" or helium star at the top of the ladder of stellar evolution. A worthy example of a star of this type is Rigel, the magnificent blue-white star in the constellation of Orion, whose surface temperature is estimated at 10,000° K. Stars of this type are all giants, all excessively hot bodies, with diameters averaging probably about ten times that of the sun, or less, and with densities not less than one-tenth of the density of the sun. After the density of the star exceeds this amount the star no longer constitutes a perfect gas. It begins to lose heat by radiation and starts on the *down-grade* of evolution. So far we have been considering the giant stars on the up-grade. Starting with a tenuous, red star of enormous volume we have seen that as the star contracted under the gravitation of its parts its volume *decreased*, its density *increased* and its temperature *rose*. Its color changed first to orange, then to yellow, yellowish-white, white and finally blue-white as the point of maximum intensity of radiation in the spectrum shifted from the infra-red in a type M star to the ultra-violet in a type B, or helium, star. As the temperature increased the bands of titanium oxide and other compounds in the spectrum of the red star gradually disappeared and were replaced by the lines of many chemical elements. These in turn gradually faded away as the lines first of hydrogen and then of helium increased in intensity until they finally predominated over all other spectral lines in stars of their respective types. These progressive changes in the spectral characteristics of stars with increase of temperature are due, according to a recent theory of great importance, advanced by Dr. Saha of the University of Calcutta, to varying degrees of ionization taking place in the atmospheres of the stars. Outer electrons of the atoms split off as a result of high temperature or intense electrical excitation. Lines of neutral elements disappear as the temperature of the star increases and lines of ionized elements take their place.

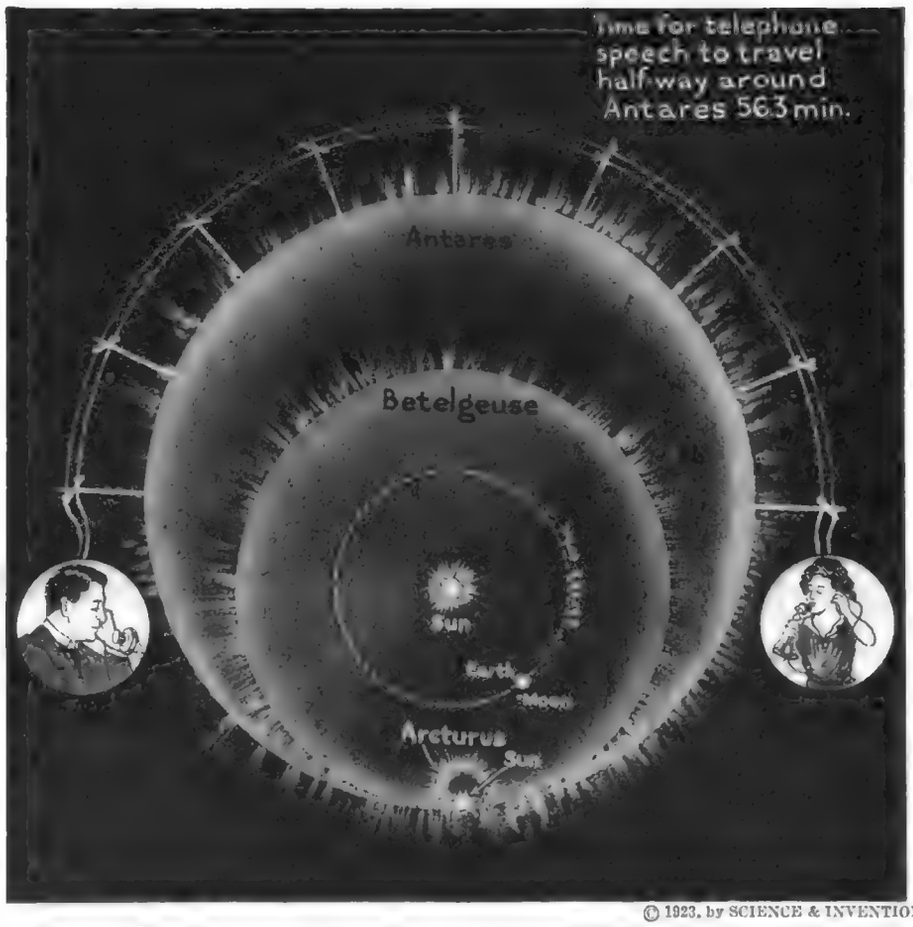
WHEN A STAR BECOMES A "DWARF"

As the star now passes over from the up-grade of evolution to the down-grade it must be classified among the dwarfs. As the density of the star increases it no longer behaves as a perfect gas and the cooling process sets in. The star goes through its spectral and color changes in reverse order as its temperature gradually decreases until finally it arrives at the state of a red dwarf star of type M equal in temperature to the red giants of the same type but in all other respects differing as greatly from them as it is possible for stars to differ. The giants of type M are at one end of the evolutionary chain, the dwarfs of type M at the other. The giants of this class are the largest and most tenuous of all the stars. The dwarfs of the same class are the smallest and densest of all the stars and they are in the stage of evolution that just precedes extinction. The difference between giants and dwarfs of the same type is the least noticeable among the hydrogen or type A stars. These stars are all intensely hot and they do not differ very greatly in size or density, whether dwarfs or giants. Sirius, the brightest star in the sky, owing to its nearness rather than to great intrinsic brightness, is a dwarf type A star and has a diameter of about one million miles. A giant of the same class might possibly have a diameter ten times as great. As we pass on down the ladder of evolution the distinction between giants and dwarfs of the successive types becomes greater and is, as we have seen, greatest for the red stars.

All stars do not climb to the top of the ladder of stellar evolution. Only the most massive giants of type M pass in succession through all the stellar types and attain the highest possible peak of development as helium stars. Less massive stars rise no higher than type A and then pass over to the down-grade and become dwarfs. Stars of smaller mass rise at the height of their evolution no farther than type F or G and then begin to decline.

The life of a star, then, depends largely

(*Continued on page* 304)



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If You Think Our Sun Is a Large Body, the Above Illustration Will Graphically Show That Antares and Betelgeuse Are Veritable Giants As Compared To Our Own Sun, Hundreds of Thousands of Times Larger Than the Sun. Although Light and Electricity Travel At 186,000 Miles Per Second, It Would Take Over Fifty-six Minutes For a Telephone Conversation To Go Half Way Around Antares. It Takes Light Over Eight Minutes To Travel From the Sun To the Earth. To Show How Tremendous Are These Suns, the Orbit of the Earth Is Plotted On the Face of Betelgeuse. We, Therefore, See That Not Only the Sun, But the Earth and Its Entire Orbit, Could Be Located In the Interior of Betelgeuse, Were It Hollow.

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Practical Motor Hints

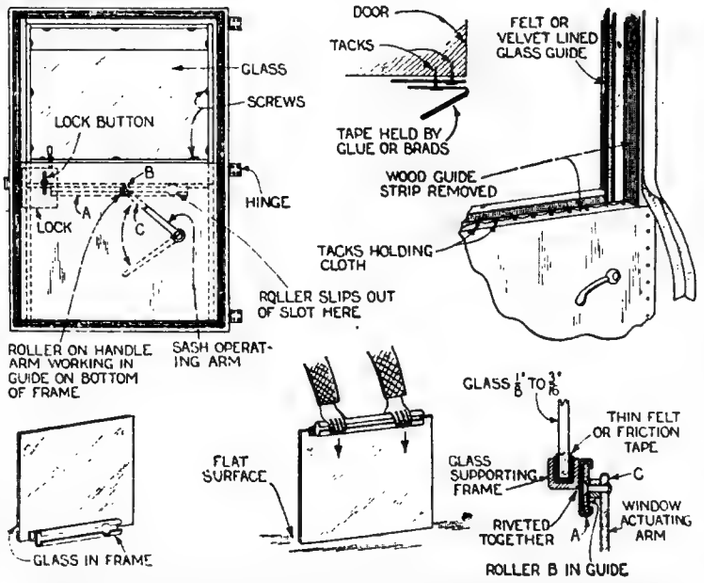
By H. Winfield Secor

REPLACING BROKEN GLASS IN SEDAN DOORS

THOSE of us who have always driven a touring car, do not know the trials and tribulations of the average owner of a sedan. It is equally true, of course, that the sedan or coupé is not a glass breaker, but it will happen now and then, especially after the car has seen a year or two of service, and the felt or velvet lined guides become worn, so that the glass is not cushioned as well as when the car was new. Another fault with some closed cars is that too thin a glass is used, such as ⅛ inch stock. The average closed car has glass thicker than this, or about 3/16 inch stock.

The most discouraging thing to the average sedan owner, is the fact that his local garageman does not care to replace broken glass in sedan windows or doors, if he can help it, as it is a thankless job, and the glass may break before he gets it in place, he apparently thinks. Likewise he is liable to soil the upholstery in having to take it loose from the door.

The writer has replaced broken glass in several closed cars, and the work does not usually take more than one and a half to two hours; once you have become familiar with the mechanism and the arrangement of the upholstery on the door on your particular car, the time required for the job can be cut down considearbly.



Replacing Broken Glass in Sedan Windows and Doors is a Job That Frequently Has to be Done by the Owner of a Car, for the Reason That Most Garagemen Do Not Care to Bother With It. One of the Commonest Causes of Glass Breaking in Closed Cars is Worn Guides, the Velvet Covering on the Metal Channels Becoming Cut or Worn Away in Places. The New All Felt Guide Material is Very Satisfactory.

REMOVING THE UPHOLSTERY

Before starting to rip the upholstery loose from the door, it is best to ask a garageman who is familiar with your car, as to how the glass is supposed to be removed from the door, as there are a few cars at least that have this feature arranged, so that by simply taking out the two side and bottom wooden window strips, the broken glass may be replaced without loosening the upholstery. Other doors again present some conundrum, and it will be found necessary to open up the glued upholstery and braid, which can usually be accomplished by pulling on it, and then to remove the tacks holding it in place with a tack-puller, or, better still, a pair of diagonal cutting pliers. After this tape has been loosened, the tacks underneath it holding the upholstery cloth in place can be removed. These features are shown in the accompanying drawings. In some cases, it will be found possible to manipulate the window raising mechanism and remove the frame and broken glass and replace the new glass in the frame, usually a U-shaped steel member gripping the glass at the bottom only, by simply loosening up the upholstery along the bottom of the window frame, and down both sides for possibly ten to twelve inches.

The lock button found on most doors is readily removed with a screw driver, and after the upholstery has been loosened up, the lock will have to be unscrewed from the door frame also. It is best to remove the two side and bottom wooden window strips as a first step.

In one type of sedan door operated by a lever, as shown in the drawing, the steel channel frame which raises the glass up and down, and in which the glass is gripped by friction tape or felt, the channel may be removed after the upholstery is properly loosened by manipulating the raising and lowering handle, when it will be found that the roller on the inner concealed arm of this handle will come opposite a slot. Just how this works in any case, should be carefully studied, and one should note just how this frame will have to be put back in place with the glass fastened in it. It is often possible to leave this channel strip in the door, and replace the new glass in it, but this is a ticklish job and more liable to cause a broken glass than when the channel frame is removed.

FASTENING THE GLASS IN THE FRAME

As shown in the drawing, the steel channel should be cleaned thoroughly of all tape or felt, and if one has handy some thin felt, such as that which comes in rolls, or equivalent stock, a strip of this about ¾ to 1 inch wide, and as long as the channel, should be cut, and one or more strips used until the frame can just be pushed good and snugly down over the glass. Hold the frame firmly, and place the glass on a flat surface, such as a piece of board, and push directly down. It should have been mentioned previously that the size of the glass frequently has to be determined after loosening up the upholstery, so as to get the exact distance between the strips in which it slides up and down, and also the proper height. Lumber yards in suburban districts, and glass and paint stores in cities, invariably have the glass of the proper thickness in stock and will cut it to your specifications. If possible, the edges should be beveled by grinding, or else with coarse sandpaper wrapped around a piece of wood, as if these edges are left sharp, particularly at the corners, they will cut into the felt or velvet lined guides, and cause no end of trouble later.

In some cases, the writer has used thin felt for wedging the glass tightly in the channel strip, while in others, several strips of common black friction tape have been used, trying two or more strips placed one on top of the other, until the channel can just be pushed onto the glass when a strong pressure is exerted with both hands. Some repairmen use glue in this operation, which helps considerably; if Le Page's glue is used, it will have to set over night, and to do this the channel and glass may be set aside for twenty-four hours after being pushed together with the glue applied to the tape or felt. In one case the glued tape, glass and channel were placed in the door completely assembled, and care taken not to raise or lower the glass for one day, the glue having a chance to set in this way.

REPLACING GLASS AND FRAME

In reassembling the door, be sure to place some grease, vaseline will do, on all the moving parts, including the inside of the channel strip where the roller moves, if you want to raise and lower the windows easily and quietly. One point which has not been mentioned, and that is, in many cases the velvet lined guides will have to be loosened at the top of the door, so they can be sprung outwards in order to get the glass in place between them. The whole affair, glass and guides are then pushed back in the window opening, the guides being fastened in position with screws, etc. There is now sold a flexible heavy felt about ⅛ inch thick, pressed in the form of a channel or guide for sedan doors. By tacking this about every 5 inches in the bottom of the channel, a very excellent job is accomplished, the glass being held very resiliently in this material.

After the glass has been put back in the door and the handle moved up and down to see that it operates correctly with the frame, etc., the finishing touches on the job are the reverse of the first operations namely, the upholstery is put in place and retacked. Small tacks about ¼ inch long, placed two and one-half to three inches apart, are sufficient. The finishing tape is held open, and a few flat head tacks placed along it to hold the back web in place; the fold-over finished surface of the tape may be glued in place, but the writer has generally found that the ordinary glues do not dry quickly enough, and it makes a good enough job to use a few thin brads to hold the fold-over web in position.

UNBREAKABLE GLASS FOR DOORS

Where the glass may be thin and frequent trouble found in consequence by frequent breaking of the glass, this problem was obviated in one case by utilizing the new so-called unbreakable glass, which comprises two or more thin sheets of glass with a layer of celluloid pressed in between. The cost of this glass, which is procurable from several houses in New York and other cities, is two and one-half to three times the cost of ordinary plate glass of the same thickness. This glass is practically bullet-proof, and is also used for windshields; if hit it may develop a crack, but it will not shatter, holding together in one solid piece.

Another trick which the writer once saw was the substitution of plate glass by sheet celluloid of the same thickness as the glass, or even a little thinner. This is obtainable from any of the large celluloid companies. It can be cut to shape with a strong pointed knife, and then by laying the marked spot over the edge of a table and bending it, it will break off.

The celluloid has a tint to it, but for periodical summer use this will not matter.

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Fig. A, Showing Lower Action of Piano, Exhausters 1, Equalizing Bellows 2, Governor 3, and X the Position of the Expression or Accenting Pneumatics.

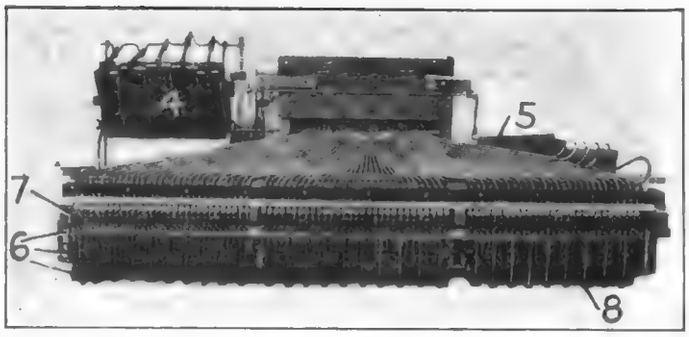


Fig. B, Showing Rear View of Upper Action of Piano, Motor Bellows 4, Tracker Bellows 5, the Three Shelves of Hammer Pneumatics 6, the Row of Striking Fingers 7, One of the Leather Nuts on Wire That Connects Pneumatic with Striking Finger 8.

Repairing Player Pianos

By FRANCIS G. LEMERLE

ANYONE who has a little mechanical ability and patience can very easily cover a player action, comparable to the factory product, with the simple tools found around the house.

Just what is meant by covering the pneumatic action of a player piano is this, viz.: All player-piano actions have numerous bellows, or pneumatics, as tuners call them. These are of different sizes and are covered with different kinds of rubber cloths as to quality, thickness, manner of coating, whether there is a layer of rubber between two pieces of cloth or whether the cloth is coated only on one side, etc.

It is a well known fact that through age these rubber cloths harden and crack, which causes the bellows to leak; this makes the action of the piano sluggish and unresponsive, hard to pump, and in some cases the piano refuses to work at all. Many silent notes on players are caused by leaks in the pneumatics that operate the hammers. The average life of the cloth on player actions is from 7 to 10 years, if it is regularly played, as this tends to offset the hardening action that goes on when they are not played for long stretches at a time, it thus becomes necessary to cover same periodically.

The average cost of having a player-action covered by tuners or sent away to the factory will be in the neighborhood of one hundred to one hundred and fifty dollars, which is a considerable sum for those of moderate means to have to spend for such work. I have known of cases where, after having spent six or seven hundred dollars for a player, the bellows went bad in less than five years, due to the instrument having been in the store a long time before it was sold. The cost of recovering added to the original cost of the piano makes music on such an instrument extremely expensive to some owners.

Recovering the Pneumatic Action of a Player Piano for Less Than Ten Dollars

As shown in photograph A, the bellows, 1, that are operated by the feet, are known as the exhausters and are covered with the heavier grades of rubber cloth, as are the equalizing bellows, 2; those of the governor, 3, the motor, 4, (Fig. B) the tracking device, 5, and accenting devices at X are covered with a lighter and more flexible rubber cloth, while the 88 pneumatics, or bellows, 6, that operate the hammers shown in photograph B are covered with an extremely flexible rubber cloth, a fine quality of thin, closely woven cotton cloth with a thin coating of gum rubber on one side. The accenting bellows are not visible in the photograph, but are in the bottom part of the piano, one on each side, in about the same plane as the governor, as is shown at X.

The tools necessary to do the work with are:

One large and one small screw driver.
An old table knife, or its equivalent.
A hammer.
Several old safety razor blades.
A small "C" clamp.
A pair of old scissors or shears.
A small knife.

The materials needed to do the work with:

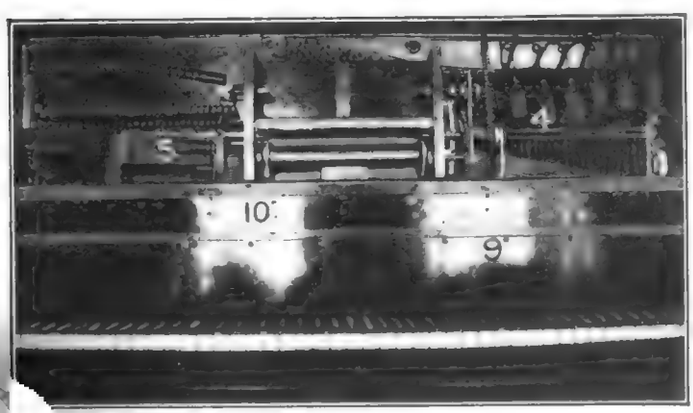
A tin can holding about a pint.
A piece of galvanized iron, about 18"x2".
A piece of square metal rod, about ⅜"x ⅜"x8".
Quite a large sheet of brown or white paper.
About a pound of the best Irish flake glue.
A small painter's fitch will suffice for a glue brush.

The above material will cost less than a dollar, and the best cloths only should be used in recovering and as near like the cloth on the bellows as possible.*

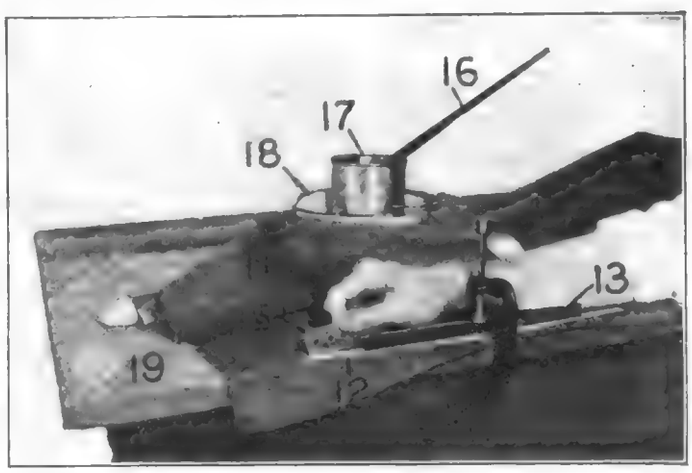
A standard pneumatic action can be covered with the following amounts of cloth, which all come approximately one yard wide, viz.: 2 yards of medium weight cloth for the governor, tracker, motor and accenting and loud pedal pneumatics; 2 yards of heavy cloth for the exhausters and equalizers; 2 yards of extremely light weight cloth for the hammer pneumatics.

(*Continued on page 272*)

*Names and addresses of firms handling player cloths, etc., furnished on receipt of stamped self-addressed envelope.



C, Showing Front of Upper Action of Piano, front "L" Board 10, Secondary Pouch Board 9, Track Bellows 5, and Motor 4.



ig. D, Showing Cloth That Covers Are Cut from 11, Template or Pattern in Position 12, Metal Rod, 13, Being Clamped Down on th Pattern r the "C" Clamp 14, Safety Razor Blade 15, Being Held in the Hand; Fitch 16, Is in the Can of Glue 17, Which is Floating in epan of Boiling Water 18, and 19 is the Table.

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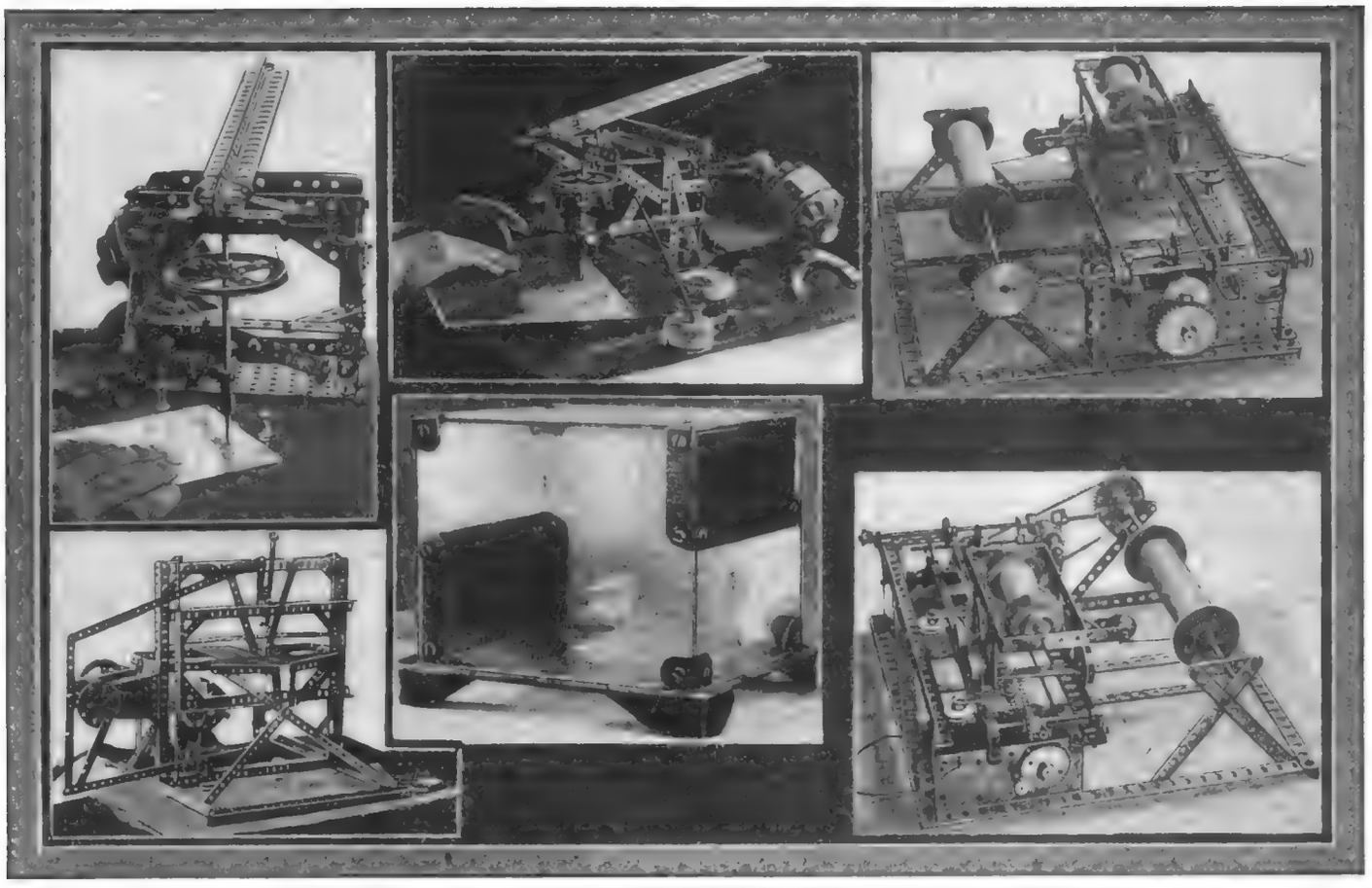

Top Row Left and Center Show the Front and Side Views of a Glass Boring Machine, Which May Be Successfully Employed for the Drilling of Glass Radio Panels or the Making of Glass Cases, as Indicated by the Butterfly Case in the Center Photo of the Lower Row. In the Lower Row at the Left is a Model of a Fret Saw Also Made Entirely of Toy Machine Parts, and at the Right the Top and Bottom Photos Are Examples of a Very Efficient Coil-Winding Machine for Winding Multi-Layer Coils or Magnets.

Practical Applications of Toy Sets

GLASS BORING MACHINE, FRET SAW AND COIL WINDING MACHINE MADE FROM MODEL BUILDING OUTFITS

By DR. ERNEST BADE

THE boring of glass is quite a tedious job if it must be done by hand, requiring careful attention and manipulation, but as soon as a number of such holes must be made, hand boring is far too slow. A little machine which will bore a hole in a few minutes through window glass can easily be made. It consists of nothing more than a frame shaped like an inverted L, and it can be made from metal strips of a building set or from a number of pieces of wood. Through the extended arm of the L, a vertical shaft is placed, which is held there by the upper and lower extensions. Between these extensions a large pulley wheel is attached. The lower part of the shaft receives a coupling into which a brass or copper tube the size of the desired hole is fastened. The upper, projecting end of the shaft is automatically weighted with a long lever-like projection, hinged to the upper arm of the L. This gives the tube which is cut through the glass a uniform pressure. A few drops of turpentine with a little carborundum placed at the point of contact of the tube with the glass is the abrasive mixture. An electric motor is connected to the pulley of the shaft with a string belt. With this device, any number of holes can be bored quickly and easily without fear of breakage. The holes may also be placed near the edge without cracking the glass. Holes for glass cages, glass radio panels, glass for electrical and physical experiments are most quickly bored in this manner.

FRET SAW

The fret saw illustrated consists of two rectangular frames of equal size, so fastened together that the one placed horizontally forms the base, while the other, which is placed vertically, lies in the center of this base. In the center of the vertical square, a table is firmly fastened in position. This is the support or rest for the work, which is to be handled. The frame, when made of metal, is much firmer and stronger than if wood were used, but if wood is preferred, then a thick hard wood should be chosen. All joints must be carefully and rigidly constructed. When the frame has been assembled, the movable frame, carrying the saw, is made. This is just as wide as the frame, but only half as high. The four outer ends travel up and down, sliding on a rod of thin pipe attached to the extremities of the vertical frame. The saw is in the center of the movable frame, and receives its tension through a stiff spring located on the upper part of this frame. The entire frame is raised and lowered by means of two long levers attached to it and to a long strip at the other end. The fulcrum is located on the main vertical frame at about one-quarter the distance from one end. The movement is produced by a short strip attached to the lower set of levers and to the outer rim of a large wheel which, by a set of reduction gears, is rotated by a motor of 1/16 h. p. by means of a round belt or even cord. Thus the circular movement of the motor is translated into an up and down movement of the saw. This movement is perfectly vertical, and, therefore, it easily saws all kinds of thin wood. If desired, a guard can be attached which will protect the fingers from coming in contact with the saw while in motion. This saw is admirably adapted for making puzzle pictures, wooden toys for children, and general fret saw work as well as for the production of smaller wooden models.

COIL WINDER

It is very tiresome to wind any kind of a wire coil by hand. It makes no difference whether it is a radio coil or a spark coil, as they all require a large amount of patience and even then the windings are not regular. As this is a most important point, all kinds of coils should be wound by machine.

A machine which will do this consists of two parts, one, a solid frame carrying the gears and the coil winding mechanism, and, second, a slide carrying the feeding wire. This last part must be made movable, and it must move sideways to a distance equal to the thickness of the wire for each revolution of the coil. To provide movement for the slide, a track is attached to the frame, and to prevent the frame from jumping the track, a lateral track in which two grooved wheels turn is also provided.

(*Continued on page* 302)

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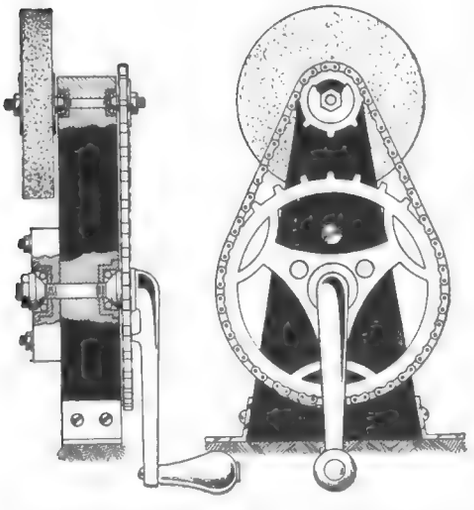
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE $15.00

TOOL GRINDER MADE FROM BICYCLE PARTS

A great many things can be made from parts of an old bicycle, one of these, a tool grinder is shown in the sketch. It is very easy to make, and is a generally satisfactory and useful article when finished. The frame of the grinder is made of a piece of hard wood, 6″ wide, 2″ thick and 12″ long. It is tapered down to a width of two inches at the top. Holes are bored one inch from the top, on both sides of the frame block, with a bit large and deep enough to accommodate the bearing cups which have been removed from the front wheel of the bicycle. Now bore a ½″ hole entirely through the block in the center of the large depressions already made. The sprocket is then removed from the rear wheel, the hole in which being much larger than the axle, upon which it is to be mounted, is filled with babbitt and drilled out the proper size. This is shown by the shaded portion in the small sprocket on



A Most Useful Tool Grinder For the Home Or Shop Made From Old Bicycle Parts. The Chain Drive Is Very Steady and Positive, While the Gear Ratio Gives a Good Velocity To the Grinding Wheel.

top. The axle is now put through the hole with the cones and steel balls in their relative positions as shown in the sketch. The sprocket is mounted on one end of the axle shaft and the emery wheel on the other by clamping them between the cone and nut as shown. The crank and large sprocket are then added to the ensemble in the same manner. The left arm of the crank is sawed off as shown above. A 1″ block is added to the thickness of the frame where the hanger bearing is supported, the block being held in place by two 3″ flat head stove bolts in the position shown. Sufficient chain is then cut off to reach around the two sprockets. The pedal is replaced with a crank handle to turn the grinder. The whole device is finally secured to the bench by two small brackets.

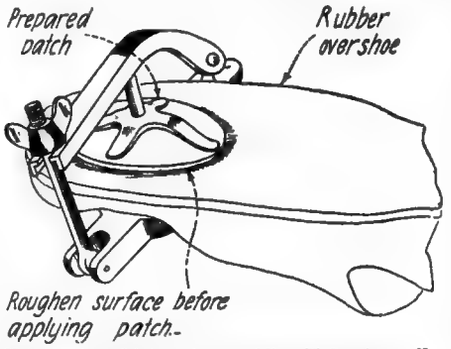
Contributed by HAROLD JACKSON.

SECOND PRIZE $10.00

VULCANIZER REPAIR FOR RUBBERS

Getting service out of one of the five-minute vulcanizers, with which every motorist is familiar, is illustrated in the diagram given here.

This means of repairing a rubber overshoe, in the same manner as repairing an inner tube, is about as simple and inexpensive as any that could be desired. A local



Using the Light Automobile Vulcanizer For Repairing Rubbers Or Overshoes—Galoshes, As the Girls Call Them.

automobile owner demonstrated this recently when a rubber overshoe he was wearing suffered a long slit in the sole, where it came in contact with a nail. The bottom of the shoe was roughed and the prepared patch clamped on and lighted.

In a few minutes a substantial repair was the result. Obviously this method will be of equal use on rubber boots.

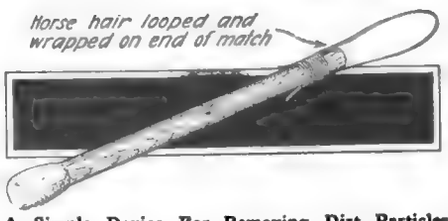
Contributed by G. A. LUERS.

HAIR PROBE REMOVES PARTICLES FROM EYE

A frequent occurrence in practically every shop is the lodging of particles of dirt in the eyes of the workman. The practice is to use a sharp stick or point of a pencil to extract these particles. Apart from the danger of their use in an unsteady hand, it is seldom that the sufferer can be induced to remain motionless while these instruments are employed.

A simple probe which is not nearly so dangerous and will work with surprising results, without fear or possibility of injury to the eye, is quickly made from a horse hair, looped over the end of a match, as is shown in the accompanying sketch. With this probe, particles which are sticking to the tissues can be dislodged without pain.

Contributed by G. A. LUERS.



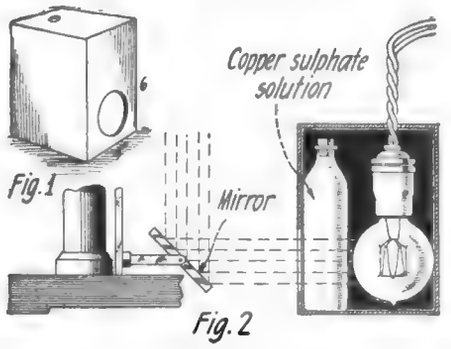
A Simple Device For Removing Dirt Particles From the Eye, Especially the Eye Lid, When It Has Been Turned Over, Is That Here Shown; It Is Made By Means of a Looped Hair Bound To a Match With a Piece of Thread.

THIRD PRIZE $5.00

DAYLIGHT LAMP FOR THE MICROSCOPE

To many contemplating microscopic work it may come as a surprise to learn that good work with the microscope cannot be done by an ordinary, unscreened electric light; it must either be done in daylight or with the aid of a specially designed sub-stage lamp the lens of which simulates as nearly as possible a north light. To those who may have an opportunity to work only at night and who do not wish to go to the additional expense of such a lamp, we herewith give an idea of a lamp that is quickly and cheaply constructed and is as efficient in every way as a lamp costing from five to ten dollars.

Procure a box (preferably a wooden one with a sliding top or back) about 4 x 6 x 5 inches, and cut in it two holes (see Fig. 1): one in the top for the admission of the flexible electric cord; and the other in the front, which should be slightly larger in diameter than the mirror of the microscope and on the same plane with the mirror. Now, fill a five or six-ounce bottle with an aqueous solution of copper sulphate made of the strength of about 7 per cent. Place the



A Glass Bottle Filled With a Copper Sulphate Solution and Placed In Front of An Incandescent Lamp, Contained Within a Box, As Indicated In the Diagram Above, Produces a Light Comparable With a North Light, and Will Enable Those Who Have Opportunity To Study Microscopic Slides At Night Only, To Obtain Better Results.

bottle in the box with an electric light in back of it, and the lamp is ready for use.

The size of the bottle is immaterial: it is merely necessary that it fits in the box and covers the hole through which the light passes. Also, the strength of the copper sulphate given varies with the strength of the light used and the capacity of the bottle. This is an average to work from and should be tested out before the bottle is wired in place. If the light is too blue, add more water to the solution; if too yellow, add more copper sulphate. The solution is of correct strength when it gives a faint bluish tint with no object in place.

If one wishes to add to the appearance and efficiency of the outfit he can paint the exterior of the box black, and tack with smallest size tacks (not glue) tin foil on the back and two sides of the interior. Fig. 2 shows the side view of the box with one side removed.

Contributed by DR. C. CRESTON COLLINS.

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RADIO DEPARTMENT

First German Train With Duplex Radiophone

By DR. ALBERT NEUBURGER

The First Train in Germany With Duplex Radio Telephony. Photos Show Two Cars Equipped With Antenna.

At the Left a Traveler Using the Radio Telephone; and at the Right the Official Who Makes the Connections to the Next Train-Station.

THERE has been installed in these days between Berlin and Hamburg the first train which contains an installation for complete duplex-radio-telephony, so that it is possible to speak during the journey with both of these towns and to carry on conversation with every telephone subscriber. The energy of the installation would be sufficient to reach also other towns, but the necessary apparatus for making the connections between the high-frequency telephony of the train and the low-frequency-telephony in the wire must firstly be established. Otherwise it is also possible to speak from each subscriber's telephone in the two cities mentioned to the running train.

The new installation was set up in an express-train, a so-called "D-train," the expression of the German service for corridor-trains. In the midst of this train there are two cars of the third class. These cars contain the installations and the telephone compartment. Putting them in the middle of the train has nothing to do with the radio-telephony, but was only done for the purpose of making it easier to reach the compartment from each end of the train. In the German cars the corridor is on the side and from it you enter into the single compartments, each of which are closed by a door.

The two radio cars are used to carry travelers and only two of the compartments are used for the radio apparatus. In one of these compartments is the radio installation; the other one is divided in two parts; one part contains the telephone. In the second sits the official, who makes the connections and who gives notice to the travelers who are called for from the cities. To the car in which we find the radio-installations is coupled a second one, which is used for taking up travelers and which also serves the purpose of lengthening the antenna.

The antenna consists of six wires which are strained out on brackets sitting on the roofs of the cars. Each car has four brackets, and on each bracket there are six porcelain-insulators to which the wires of the antenna are fastened. The length of each wire is 16 meters and, as the wires of the two adjacent cars are coupled, the total length of the antenna is 32 meters. All the wires together have a length of 192 meters. The antenna serves for sending as well as for receiving. Its height above the earth is virtually 40 to 50 centimeters on account of the metal of the car beneath it. It is impossible to make the antenna higher as the height of the bridges, tunnels, etc., through which the train must pass, doesn't allow it. The wave-length is 3,000 to 4,000 meters. Longer waves on the train only can be obtained by lengthening the antenna over a greater number of cars.

The current is taken out of the storage-battery, which also is supplying the necessary energy for lighting the car. There are two systems for electrically lighting the railroad-cars in Germany. The older one works with storage-batteries which are charged after each journey in the terminal stations; the newer system works with generators, fixed on the axles between the wheels. The current can just as well be taken from these machines. The radio-installation works with high-frequency energy of 10 to 15 watts in the antenna. The continuous current of the storage-battery, which has a potential of 24 volts, is transformed into continuous current at 600 volts and made fitting for radio-purposes in the common way with aid of an oscillation valve which feeds the antenna with high-frequency energy. Besides this oscillation valve the sender contains a second valve which serves for the purpose of modulating the high-frequency oscillations in the rhythm of the human language given by the microphone.

The receiving apparatus contains a closed oscillatory circuit which is excited by the arriving oscillations and magnified by an audion-detector and one or two amplifiers.

At the outskirts of Hamburg as well as of Berlin, there have been installed new offices, the so-called "Zugstationen" (train-stations). One of these stations is in Bergedorf near Hamburg, the other one in Spandau near Berlin. They serve for the purpose of receiving the waves coming from the train and to make the connection with the common interurban telephony in the wire.

The connection of the high-frequency installation with the common lines of the postal telephone service (in Germany the telephone is monopolized by the governmental post-office) is made with aid of a switch in the same way as always if two subscribers are to be connected. The only difference is, that one of the "subscribers" works with high-frequency, the other one with low-frequency, the frequency caused by the human voice in the common telephone-lines. There is nothing new to say about the switching.

If a traveler wishes to speak he goes to the compartment, which contains the telephone apparatus. He takes off the receiver and repeats the number of the subscriber with whom he intends to converse. The official in the train makes the connection and the conversation can begin. But the system used is such a one, that the connections can also be made directly without the aid of an official. The train first is connected with the "Zugstation" and this station calls for the subscriber in the town. If this one is ready to speak the traveler is invited to begin by the official. He hears the words: "Please speak." The official has nothing to do with the system. His presence is made necessary for other reasons: he collects the fees, he seeks in the trains the persons called for at the telephones; he also can take up orders for rooms in the hotels, for autos at the station, etc. These orders he gives by radio-telephony from the running train.

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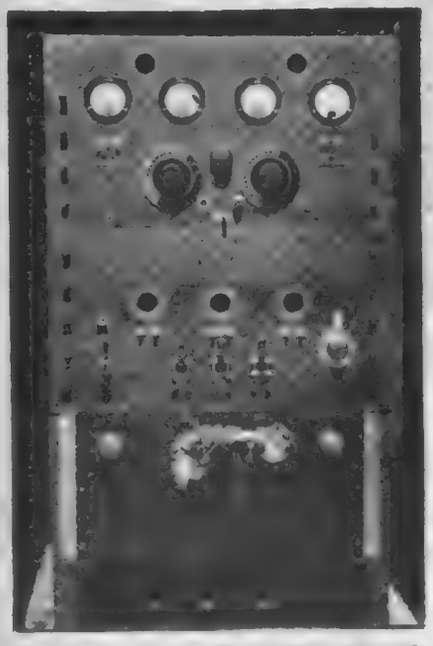
BROADCAST-STATIONS

Station W. G. A. T., Operated by the American Legion of the Department of Nebraska is Shown at the Right. The Station is Used for the Purpose of Keeping Public in Touch with the Activities of the Legion and Advertises Nothing but Americanism. Its Programs Are Well Arranged and Consist Usually of a Short Lecture or Address Followed by classical or Popular Music. The Programs Usually Run from 9 to 10.30 on Friday Evenings, But Are Sometimes Extended to Midnight. All Programs Are Opened by the Bugle Call of "Assembly" and Concluded by "Taps."



Above and at the Left Center Are Shown Photographs of Station W. F. A. G. of the Radio Engineering Laboratory, Located at Waterford, N. Y. This Station Broadcasts Wednesday and Saturday Evenings and Sunday Afternoons. They Radiate Five Amperes and Have a Very Creditable Record Among the Broadcast Listeners. To the Left is Shown the Operating Room of Station W. C. A. K., Owned and Operated by Alfred P. Daniel, Assistant Division Manager of the A. R. R. L., Southern Texas Section, Located at 2504 Bagby Street, Houston, Texas. The Station Broadcasts on Wednesday Evenings and Sunday Afternoons. The Owner Claims That This Station was the First to Broadcast a Concert in the South in September, 1921

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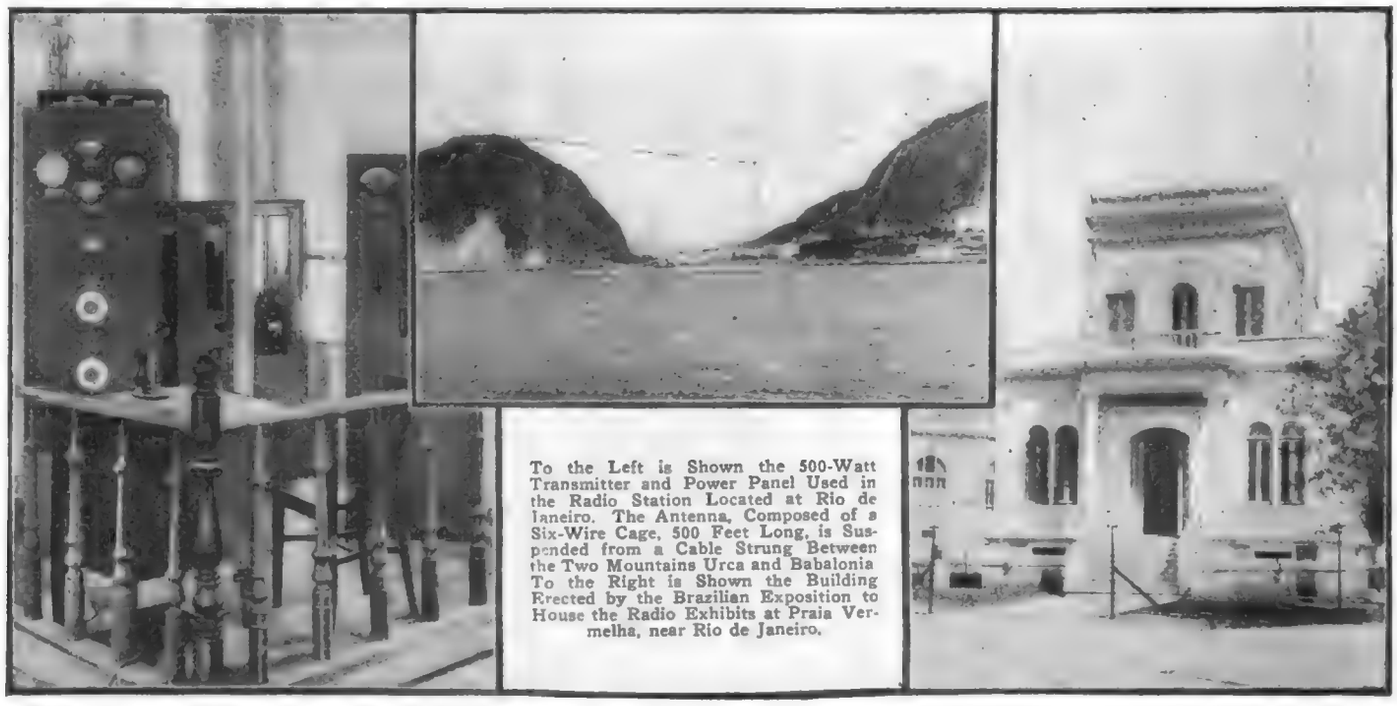


To the Left is Shown the 500-Watt Transmitter and Power Panel Used in the Radio Station Located at Rio de Janeiro. The Antenna, Composed of a Six-Wire Cage, 500 Feet Long, is Suspended from a Cable Strung Between the Two Mountains Urca and Babalonia To the Right is Shown the Building Erected by the Brazilian Exposition to House the Radio Exhibits at Praia Vermelha, near Rio de Janeiro.

New South American Broadcast Station

TO the station of the International Western Electric Company located at Rio de Janeiro belongs the remarkable record of 8,000 miles broadcasting range. This was accomplished with a 500 watt radio transmitter and programs have been heard by the Government radio station located in Honolulu. It has been computed that a radius of 8,000 miles drawn around New York City would take in all the land on the globe with the exception of Australia, New Zealand and a few small islands on the Pacific Ocean.

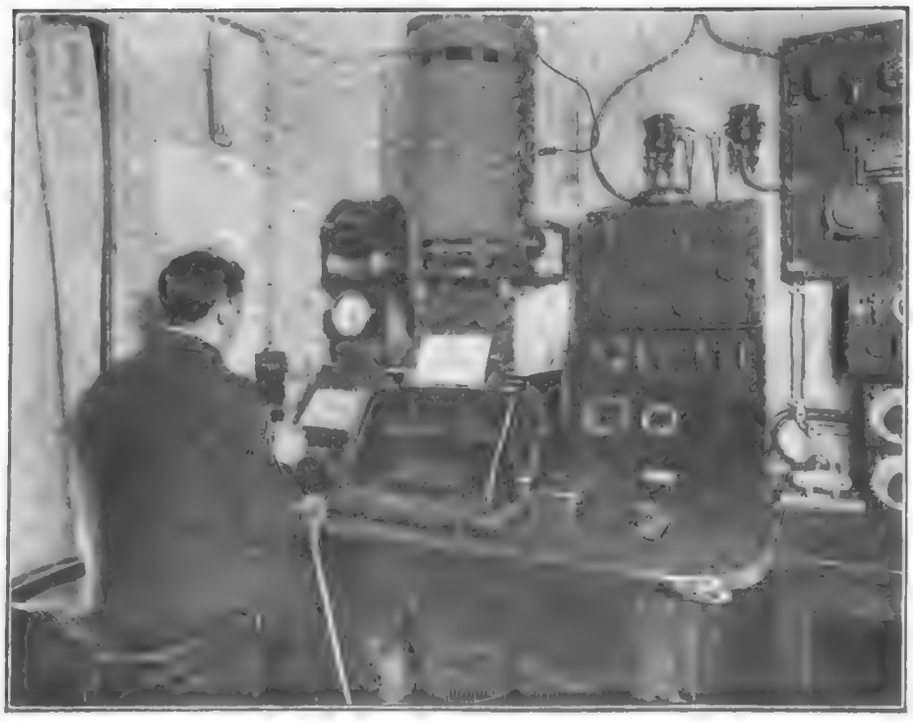
The antenna suspension used at this station is unique in that a vertical aerial is used. Cables are run from the summit of one mountain to that of another directly opposite it. From the center point is then suspended a six-wire cage 500 feet long. This is shown in one of the accompanying photographs.

The apparatus, which was installed during the Brazilian exposition at Praia Vermelha, a suburb of Rio de Janeiro, is situated in a beautiful building of white stone, which is occupied by the National Telegraph Company. The apparatus consists of a standard 500 watt transmitter, the same as that used in many of the broadcasting stations throughout the Unied States. During the exposition spoken of above, musical programs were broadcasted from this station and received and amplified so that many of the thousands of visitors at the exposition were able to enjoy them. This station was also used in a point to point demonstration between it and another station located eighty miles distant. This form of communication differs from ordinary broadcasting, as it is possible to carry on two-way conversation, since both stations are equipped with transmitting and receiving apparatus.

High Speed Radio Transmitter and Receiver On Board Ship

SOME time ago the White Star liner *Majestic*, the largest ship afloat, was equipped with a high speed transmitter for communication between ship and shore. This, however, allowed transmission in only one direction; that is from ship to the shore while in the opposite direction communication had to be carried on by the manual method. However, the earlier experiments were so successful that the Marconi Company has installed on board complete apparatus for both transmission and reception at a speed of eighty words per minute. Part of the apparatus is shown in the accompanying photograph.

Ordinarily a speed of greater than twenty-five words per minute cannot be maintained by an operator transmitting with the ordinary key and the high speed apparatus has been installed in order to meet the demands of increasing radiogram traffic. With this new apparatus it is possible to handle three times the amount of traffic. These high speed signals have been transmitted to and from this vessel when one thousand miles at sea and wireless press has been completely and perfectly recorded by the automatic receiver on board the *Majestic*



The Photograph at the Left Shows Part of the Transmitting and Receiving Apparatus Designed for High Speed, Automatic Transmission and Reception on board the "Majestic."

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$200.00 Single Tube Radio Contest

SIMPLICITY in radio is becoming more and more the goal of all radio experimenters. There is no doubt that in radio the vacuum tube rules the land at the present time. There have been described many hundreds of different single tube hook-ups, but we believe that somewhere one will be found superior to what has appeared so far.

In order to locate it, we are willing to pay prizes to the ones who can show us the *best "single tube" hook-ups*. It makes no difference whether the hook-up submitted to us is of the regenerative type, a reflex, radio frequency, and detector or any combination of the three—or, for that matter, something entirely new.

With a single tube hook-up, as, for instance, a super-regenerative, it is possible to pick up radio concerts from over 1,000 miles and more—and concerts have been reported as coming in on a loud talker from such a distance.

Then there are other hook-ups which do not reach so far, that are better for local work, and bring in the sounds with a great volume, on a loud talker.

It seems that at the present time the public really wants something that is simple and that brings in the sounds loudly from local stations, rather than covering great distances with a pair of head receivers.

The judges, therefore, will have their eyes open for long distance hook-ups, or short distance hook-ups that can be used best with loud talkers.

As will be seen in our list of prizes, there are two series—one for the long distance "DX" types, and one for the short distance "loud talker" types. The best of each group will get similar prizes.

The sets that the prizes go to should be easily tuned, and there should be a minimum of interference for the sets of each group.

Furthermore, the judges will look out for the set of the greatest simplicity. Naturally the more apparatus employed and the more complicated the set is, the smaller will be the chances for a high prize. The high prizes will therefore probably go to those sets having the simplest circuits, with a minimum of apparatus contained therein.

The following rules must be observed:

RULES FOR SINGLE TUBE CONTEST

Not more than one vacuum tube can be used.

FIRST PRIZE
"DX" Set, $50.00 in gold.
"Loud-Talker" Set, $50.00 in gold.
SECOND PRIZE
"DX" Set, $20.00 in gold.
"Loud-Talker" Set, $20.00 in gold.
THIRD PRIZE
"DX" Set, $15.00 in gold.
"Loud-Talker" Set, $15.00 in gold.
FOURTH PRIZE
"DX" Set, $10.00 in gold.
"Loud-Talker" Set, $10.00 in gold.
FIFTH PRIZE
"DX" Set, $5.00 in gold.
"Loud-Talker" Set, $5.00 in gold.
Total, $200.

Any vacuum tube may be used, whether using two or three elements or more. Dry battery tubes, or storage battery tubes, can be used at the designer's option.

The circuit (the arrangement and layout of the parts) should be different from anything that has appeared in print heretofore —or otherwise some new feature should be embodied in the outfit, that was not used or published previously.

It is absolutely necessary that the circuit or hook-up has been actually used in practice, as mere ideas and hook-ups are not eligible in this contest.

As a proof of this, all contributors must submit their outfits to the editors, who will test the outfits themselves, under the usual conditions, and will be guided by the performance of the outfit in awarding the prizes.

A manuscript of not more than 750 words should accompany the outfit.

Where standard instruments, such as condensers, tubes, etc., are used in assembling the circuit, they should be individually named in the manuscript.

A good diagram of the connections, well executed in ink, must be furnished.

A photograph of the builder is also required.

All outfits, photographs, diagrams and other data, sent in by contestants, which have not been used by the publishers, may be returned at the publishers' own expense.

Outfits are to be sent by Parcel Post or Express, Prepaid. Expenses for such transportation both ways will be refunded by the publishers.

All models or outfits will be promptly returned to the builders.

More than one outfit may be entered by contestants.

The contest is open to every one, radio club members included, except manufacturers of radio apparatus.

All prizes will be paid upon publication.

Where two contestants submit the same prize-winning idea (constituting a tie), the full prize will be paid to each.

This contest closes in New York on August 15th, midnight, and the first prize-winning article will appear in the November, 1923, issue.

Address all outfits and all correspondence pertaining to this prize offer to *Editor, Single Tube Prize Contest*, in care of this publication.

That Radio Record

THERE is one item referring to radio sets that I have never seen in print. It is the record. This is a very important point if you expect good results from your set, but how neglected it is can easily be seen by visiting a few friends who have receiving stations. For instance, friend No. 1 probably doesn't keep a record at all. He turns the knobs and dials at random, and says something like this: "WOC usually comes in somewhere around here," and when finally he gets something it is probably, "How to grow turkeys" from some other station altogether. While friend No. 2, even though he jots down his settings as he gets them, in a book, has as the result that he is obliged to hunt all through the book to the setting he wants, only to find that the results from that setting are not good. So he has to start all over again. The purpose of this article is to show a good comprehensive record that anyone can keep, thereby assuring amateurs of deriving more pleasure and efficiency from their set.

First obtain an exercise book, preferably of a good quality for the sale of appearance, then rule the pages as shown in the illustration. Of course, if your set has different controls, the lines would have to be arranged differently, but the general scheme will be the same. A full page is allowed for each station and an index is kept on the first page. In the example shown, Fig. 1 is for standard variocoupler, two variometer type, while Fig. 2 is single circuit tuner. A column is ruled for each dial or switch and is marked as shown by abbreviations, grid V. meaning grid variometer, coup. meaning coupling, etc. All switch points are numbered. The remark column is left for putting down results, such as loud, clear, not so loud. Of course it could be written in abbreviations, such as Vol., Med., meaning volume medium, etc. A space is allowed on each page, as shown, for the schedule.

Contributed by T. HARTLEY HALSTEAD.

REGINA LEADER C.K.C.K.

SUNDAY	9 P.M. GRAMOPHONE RECORDS					
MONDAY	1 P.M. MARKET REPORTS			7 30 P.M. G. RECORDS		
TUESDAY	1 P.M. " "			7 30 " SPECIAL CONCERT		
WEDNESDAY	ETC..					
THURSDAY						
FRIDAY						
SATURDAY						

SETTINGS

DATE	SWITCH UNITS	SWITCH TENS	COUP.	GRID VAR.	PLATE VAR.	REMARKS
20/12/22	4	2	48°	120°	116°	CLEAR VOL. MED..
22/12/22	4	3	42°	116°	123°	CLEAR VOL. LOUD

FIG. 1.

REGINA LEADER C.K.C.K

SUNDAY	9 P.M. GRAMOPHONE RECORDS..					
MONDAY	ETC..					
TUESDAY						
WEDNESDAY						
THURSDAY						
FRIDAY						
SATURDAY						

DATE	SWITCH UNITS	SWITCH TENS	VAR. COND	FEED BACK	REMARKS
20/12/22	4	3	120°	84°	CLEAR VOL. LOUD.

FIG. 2.

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Rear Panel View of the Sharply Tuned Detector and Amplifier Set Here Described.

Front Panel View Together with Cabinet and Horn of Loud-Speaker of the Dial Control Set.

Sharply Tuned Detector and Amplifier

By BERT T. BONAVENTURE

WHAT are the qualifications of a good radio receiving set? Selectivity, yes. Freedom from body capacity, yes. Ease of operation and control, yes. In other words, a good receiver must be able to "deliver the goods" in the above respects. The following describes a set that is good all-around from start to finish. It has all that one could desire of a set of its type and possesses some rather novel features. Contrary to a hasty impression that might be formed on glancing at the photographs, it is not difficult to operate.

Let us now examine the design. The tuning element naturally comes first. It provides a double circuit, loosely coupled, regenerative receiver, with a wave-length range of from 150 meters to 550 meters. In the antenna circuit we have the series condenser and the primary inductance. Inside of the primary rotates the secondary, which is connected to another coil known as the secondary load. Another coil similar to the secondary and mounted in the same fashion serves as the tickler or feed-back coil. The secondary circuit is tuned by a condenser across both the coils. The advantages of this arrangement are manifold. The system regenerates over the entire wave-length band and is sharp in tuning abilities.

An aluminum shield serves to hold stray capacity down to an irreducible limit. With the set operating to heterodyne a signal, the hands can be brought to any dial on the front of the set without changing the beat frequency. Especially at short wave-lengths, a small amount of capacity produces a large change in frequency. An idea of how efficient the shielding is can be realized when we think of how our old set squeals when we come within six inches of the controls. In addition to the shield protection, the coils are placed well back from the panel. This also reduces the chances of stray capacity affecting the set. The movable plates of the two variable condensers used are connected to ground. Should the stationary plates be connected to ground, and this method would be far easier from the constructional point of view, the movable plates are then the high potential side of the condenser, and in such case the shaft of the condenser projects through the shielding. Bring your hand up to a set connected in this manner, and you will realize that here the shield is useless. The movable plates must be connected to ground.

It is advised, however, if the builder cares to go through the extra trouble, that the aluminum shielding be split up into sections, each section to be placed back of the instrument it is to shield. This method, while more laborious, is the more efficient of the two. The eddy currents present in the shielding do not produce as large losses when the shielding is in small sections as when the shielding is all of one piece. It is comparable to the reason for laminating the armature of a generator instead of making it out of one solid casting. The writer does not question the desirability of the individual shielding, but has used the solid shield for practical reasons. First, aluminum is difficult to solder. It requires a high temperature to melt the special solders and when it comes to connecting the individual shields to ground, the bakelite carbonizes under the heat applied to the aluminum solder. Then, too, added difficulties present themselves, when it comes to mounting the shields on the panel, as the entire condenser must be well insulated from the shield. It is better to use a heavy stock of aluminum since it is rigid and need be fastened at but few places to mount it. It is not advised to buy thin copper foil to be cemented to the panel. The adhesive will dry out and the shield will come off, much to your disgust.

Note the dial controls. Looks good, doesn't it? Note the pleasing, symmetrical lay-out. Note that there are no binding posts or screws showing on the face of the panel at all. The necessary binding posts are on the back of the cabinet. There are no screws holding the panel in place because the cabinet is so constructed that the panel fits into a slot recessed along the top and sides. The base of the cabinet is not recessed and the bottom of the panel rests on its upper surface. From past experience with switch points on the face of a panel, one knows how carefully the drilling must be done to produce a neat job. Then, too, the switch points are bound to tarnish when exposed. Why not put them back of the panel where dust and dirt cannot get at the contacts? That's precisely what has been done.

Note that, although there are two tubes used in the set, there is only one rheostat, and that is all that is necessary. It is only the detector tube which requires an adjustment of the filament current, and a vernier rheostat has been provided for that purpose. The one stage of audio-frequency amplification has the filament of the tube controlled by amperite, an automatic filament current adjuster, since this tube needs no critical adjusting. Without exaggeration, these little cartridges actually take care of battery voltage fluctuations to such an extent that they afford the protection of a fuse. When using six volts on the A battery binding posts and a U. V.-201 A tube as the amplifier, it is possible to replace the 201-A by a W. D.-12 or W. D.-11 with an adapter and yet not blow out the 1½-volt tube. The Amperite cartridge for that particular current value (.25 ampere) permits this remarkable feat.

To start the set functioning, the telephone receivers are simply plugged into the jack. An automatic filament control switches on the filaments when the plug is inserted.

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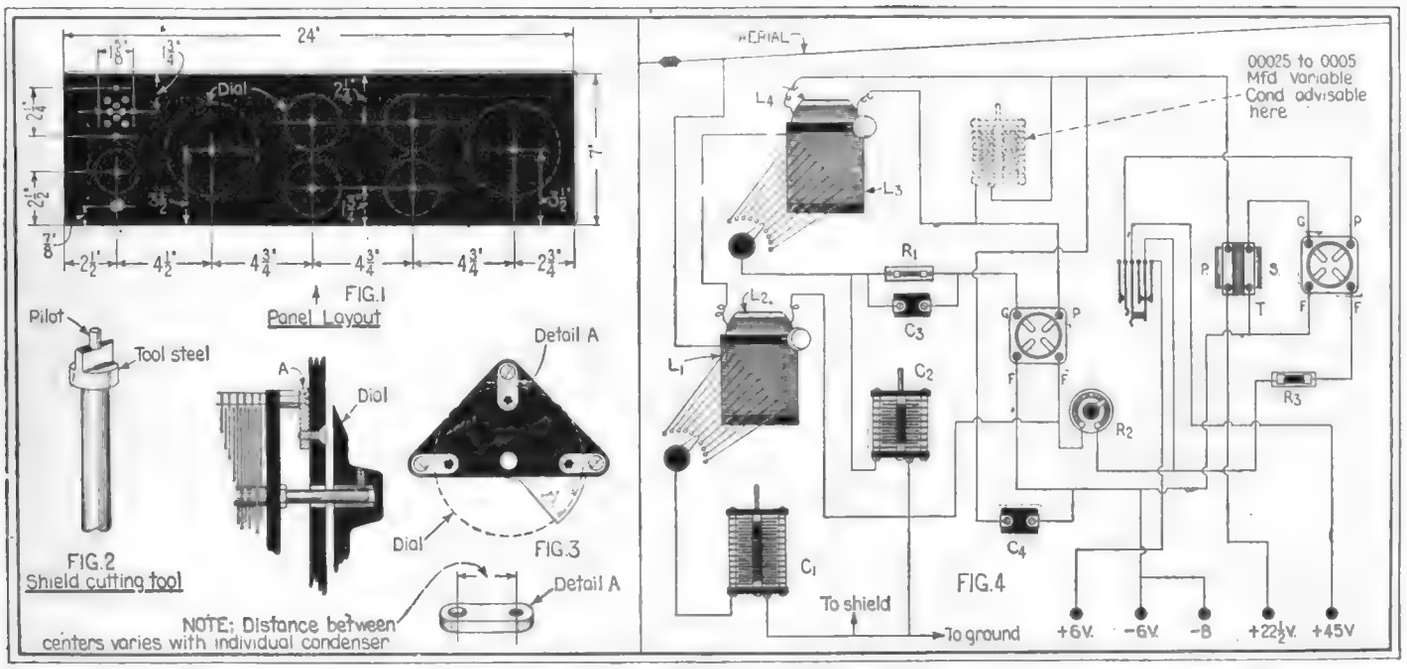

Details for Drilling the Bakelite Panel Are Shown in the Left-Hand Drawing, As Well As Scheme for Mounting Variable Condensers, So That the Screws Will Not Show Beyond the Dial. The Hook-up for the Complete Set is Shown in the Diagram, Fig. 4, at Right.

When one finishes receiving there is no fuss or bother about removing wires from the storage battery. Withdraw the plug and the set is "dead." Thus if you put your phones away, the set is rendered useless to anyone you desire to keep away from the outfit. The method saves the cost of a filament switch and saves that much panel space. Besides, the insertion of any other instrument on the panel would destroy the symmetry.

Rear connections to the set have been used throughout. We all know how unsightly the lead-in and ground wires are beside a perfectly good looking panel. Therefore, they were relegated to the rear, as were the battery binding posts.

A departure from everyday practice is the reversal of the controls. They proceed from right to left instead of from left to right. This was done to accommodate the set to local conditions. The lead-in came in on the right and to keep the lead-in short, the set was constructed so as to operate from right to left. This is optional to the builder. If your lead-in comes in on the left, merely make a note that you will mount your instruments on the reverse side of the panel when you assemble.

CONSTRUCTIONAL DETAILS

Below is a list of the apparatus required for building the set.

One cabinet
One bakelite panel 7" × 24" × 3/16" for same
One aluminum shield 6⅝" × 23¼" × 1/16"
Two variocouplers
One 43-plate 0.001 Mfd. variable condenser
One 11-plate condenser
Two panel mounting multi-point switches
Two tube sockets
One vernier rheostat
One filament control jack
One audio-frequency transformer
One 0.00025 Mfd. grid condenser and grid leak
One 0.001 Mfd. by-pass condenser
One Amperite and mounting; type depends on tubes used
Two 4" dials
Two 2½" dials
Twelve binding posts
One shelf of bakelite 7" × 7" × 3/16"
One strip bakelite 7" × 1" × 3/16"
One strip bakelite 2" × 1" × 3/16"
Two brass angles

Miscellaneous brass stock for mounting variocouplers.

Special coils were designed for this set and Litzendraht (stranded) wire was used for the windings. The table below gives the data:

WINDING DATA ON COILS

Coil	Diam.	Length	Winding	No. of Turns	Taps	Inductance†
Primary	3⅞"	3¼"	40 strand No. 38 Litz.	66	10	414*
Secondary	2¾"	2¼"	do.	40	none	88.7
Secondary load	4"	1⅞"	20 strand No. 38 Litz.	53	8	350†
Tickler	3"	1¼"	do.	35	none	160†

*Microhenries. †Approximately.

Note: The length and diameter given are the actual dimensions of the coil itself. The tubing should be made longer for mounting purposes. The tickler coil winding may be reduced to about 25 turns.

But these need not be strictly adhered to. Almost any two similar variocouplers on the market today will serve the purpose. In fact, one of the original couplers used in the set was badly damaged and another bought. The bakelite forms were used on which to wind the Litzendraht wire and the mounting was changed somewhat. This coil is the secondary load and 180° tickler, as shown in the photograph.

Two 180° variocouplers may be used if desired or two 90° ones, as the builder chooses. One 90° and one 180° are best, however, when used as illustrated. Fig. 1 gives the panel lay-out. A drawing of this may be made on a sheet of paper which can then be used as a template for drilling. Otherwise the holes will have to be laid out on the panel, using scriber, square and ruler. The same holes have to be drilled in the shield, only in some cases they will be larger; for instance, around the condenser and variocoupler shafts, around the jack and rheostat, and also around the switch shafts. The peep hole design is optional and the same size of drill may be used here on both shield and panel. While drilling the shield make provision for two small flat-head machine screws which will be used, with nuts and washers, as binding posts to which the ground connections are made. This is done to obviate the necessity of soldering connections to the aluminum itself, a difficult operation.

Fig. 2 illustrates the special cutting tool which is used in drilling the larger holes in the relatively thin aluminum sheet. A large, ordinary twist drill will find it hard going to drill the thin stock. Use plenty of oil when drilling the aluminum and use a slow speed.

Dimensions for the mounting holes for the variocouplers and variable condensers are not given as these will vary with the manufacturer. Should the mounting screws on the variable condensers be so placed that they will not be hidden by the 2½" dial, use the idea pictured in Fig. 3. This method of mounting will hide the screw heads. On the first variocoupler, your reseources will be taxed to secure a firm and solid mounting and still not have the screws show. The series antenna condenser is handy and may be used as an extra support. (How this was done may be seen in the photo of the rear of the receiver.)

When using the rear-mounting, inductance switches, the rim or edge of the insulated base may be also used for pinning the shielding panel. Some other points available for holding the shield against the panel are the condenser mounting screws. Use mica washers under the condenser to insulate the stationary plates from the shield. Still another part was used for two purposes. This was the jack, which holds both the shield and one of the brass angles firmly against the panel. This angle cannot be seen in the photograph as the jack is right above it. The brass angles are to support the auxiliary shelf on which are mounted the detector and amplifier units. The other angle is held to the panel by two machine screws, which are hidden under the four-inch tickler coil dial. The cabinet cover does not open the entire length. Only a short fixed hinged piece, 7" from one end, permits the tubes to be put into the sockets.

Mount the sockets, transformer and condensers on the 7" × 7" shelf, using machine screws and nuts to fasten the different pieces of apparatus. The photographs of the rear of the receiver show a good plan to follow. The bakelite strips are used to mount the binding posts and are fastened by wood screws in the rear of the cabinet. Holes are drilled through the cabinet so that the ends of the binding post screws do not touch the wood and thus allow the mounting strip to rest against the surface of the cabinet Rubber covered stranded wire is used to make connection from the outside set of binding posts to the terminals on the amplifier shelf. For the aerial and ground bind-

(*Continued on page* 295)

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The Reinartz Tuner

By LEROY WESTERN

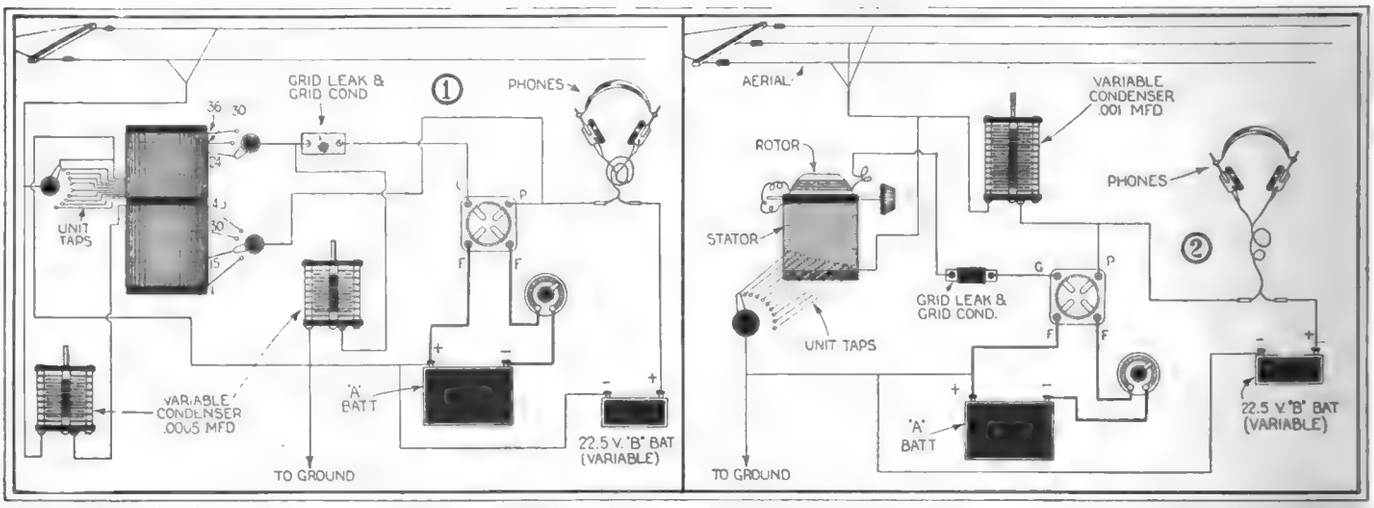

Fig. 1 Shows the Original Reinartz Circuit, Which is an Adaptation of the Old De Forest Ultra Audion Circuit. This Gives Excellent Results on DX Reception of C.W. Signals, and Radiophone Concerts.

The Improved Reinartz Circuit is Shown in Fig. 2 and Makes Use of a Standard Vario-Coupler Form, with the Windings Changed as Described in the Text. Fig. 2 Gives Slightly Better Results Than Fig. 1.

IN the course of a search for the most efficient "DX" receiver the writer some time ago, came upon a short article putting forth the merits of a tuner developed by a Mr. John L. Reinartz. He tried this initial effort of Mr. Reinartz's with some of his own changes, and attained such good results that he is giving the data on the same herewith. Several adaptions and changes which have been made on this set since its inception will be discussed later.

WINDING DATA

The original tuner, at least to the writer's knowledge, was wound on a single tube, with both grid and plate windings placed side by side. The core for these windings should consist of a three-inch bakelite tube and the coil should be wound, following the directions given below. Beginning one-quarter of an inch from the end of the tube wind 45 turns of No. 20 D. C. C. wire, or better still "Litz." The latter will give the greatest efficiency. This winding is tapped at the first, fifteenth, thirtieth and forty-fifth turns and constitutes the plate or feed-back coil. Three-eighths to one-quarter of an inch from the end of this winding should begin the grid coil. This is to be wound with 36 turns of the same size wire as was used in the plate coil tapped at the first, second, third, fourth, fifth, sixth, seventh, eighth, ninth, tenth, twenty-fourth, thirtieth, and thirty-sixth turns. These taps are brought out to two switches as shown. It is important that all connections on this tuner be soldered in order to obtain any kind of results at all.

SPECIAL FEED-BACK CONDENSER USED

One of the important points in connection with this circuit is the so-called feed-back condenser, connected in series with the plate coil, which may consist of a standard variable condenser having a capacity of .0005 mf. This capacity controls the oscillation and regeneration of this receiver which is capable of extraordinary work in the reception of C. W. signals. The condenser which is shunted across the grid and plate of the vacuum tube is very essential to the operation of this circuit and the finer tuning depends entirely upon it. This condenser should be equipped with a vernier in order to make fine adjustment possible, which becomes quite necessary when receiving from certain stations through severe QRM.

This type of tuner, however, was soon replaced in the writer's estimation by a later adaptation of Mr. Reinartz, in which conductive coupling is used, depending somewhat upon the variometer action. The circuit for this tuner is shown herewith and its construction is extremely simple. On a 3½" tube are wound 30 turns of No. D. C. C. or "Litz" wire tapped every turn for the first ten turns. Within this tube is placed a rotor, upon which are wound 30 turns of the same size wire. These two elements are connected togther and to a vacuum tube as shown here. The number of switches used are reduced by two when this circuit is employed and its control is much simpler; besides, this circuit will yield louder signals due to the conductive coupling which is not found in the first circuit described.

Of late, the "Saturday Joke Books," well known to residents of New York and vicinity, have published article after article on the construction of a Reinartz tuner wound on a spider web form. If the builder desires to employ this type of tuner he may proceed with the winding using practically the same constants as were given for the inductivity coupled tuner. Some changes more or less will be necessary in the number of turns although those given will work. The spider-web form for this work should be approximately six inches in outside diameter and the slots should be cut two inches deep. The hook-up when using this coil will be the same as shown for the set first described.

ROTARY COIL FOR PLATE FEED-BACK

An experimental set along still different lines was built by the writer which employed the constants given in connection with set number one, with the exception that the grid coil was wound on a stationary tube and the plate feed-back on a rotating tube. This, however, necessitated the bringing out of taps from the rotor which entailed considerable work which the builder will not find necessary. The reader, however, might obtain results by attempting this form of construction and at any rate experimental work along this line would be extremely interesting.

Any of the sets described above will give excellent results for long-distance reception with a single tube, and amplification may be added if desired. This set stands preëminent in the reception of C. W. signals, inasmuch as signals can be tuned in and held with a minimum of tube noises and whistles due to body capacity. An important point in connection with the condensers should be mentioned before closing; the movable plates of the feed-back condenser should be connected to the antenna and the movable plates of the tuning condenser to the ground.

A Silvering Solution

To the amateur who makes his own set and wants it to look as attractive as possible, this inexpensive silvering solution will be of value.

Metal dials, screws, bus bars and other parts are given an attractive satin [illegible] of pure silver by immersing in [illegible] only a few seconds. Iron, co[illegible] articles may be plated; [illegible] firmly attached and will not flake off. Obtain one-half an ounce of silver nitrate, one ounce of hyposulphite of sodium and one pint of distilled, or rain water. Mix the silver nitrate in the water and add a few crystals at a time of the hyposulphite of sodium in the solution. The liquid will turn brown in color, but as the amount of hyposulphite of sodium is increased, a black precipitate is formed. An excess of the hyposulphite will do no harm.

Metal articles placed in the solution are plated with silver through a galvanic action. Greasy articles should be cleaned in a bath of dilute sulphuric acid before being placed in the solution.

Contributed by L. M. Correll.

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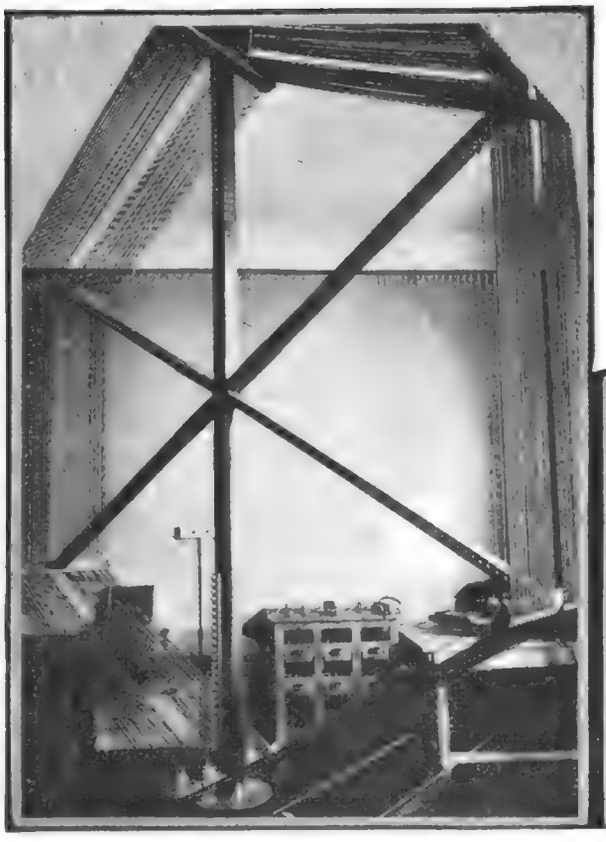
Forecasting Weather by Radio



On the Left is Shown the Large Loop Antenna Used by Professor Rothe in Conducting His Experiments on the Forecasting of Weather by Means of Radio Reception. This Loop, in Spite of its Exceedingly Large Size, is Very Easily Handled and it May Be Carefully Adjusted When Listening for Weather Indications. A Peculiar Form of Winding is Used on This Antenna and Can Plainly Be Seen in the Photograph. It is a Combination of the Solenoid and Spiral Types, Which Construction Has Been Found to be the Best for the Purpose. Below is Shown the Receiving and Recording Apparatus Employed in Connection with this Loop, Consisting of a Multi-Stage Amplifier and Various Other Apparatus Found Necessary. The Young Lady Seated at the Table is Engaged in Making the Records of the Various Sounds Heard in the Receivers.

THE weather forecaster or *"rain maker,"* as he is sometimes called, may soon be conducting his work with a pair of radio receivers on his ears, if the experiments conducted by Professor Rothé of the Faculty of Science at Nancy, France, are as productive of results as he believes they will be. For a period of twelve years the professor has been experimenting with radio apparatus for the detection of approaching storms.

There is not a radio operator, or for that matter, a broadcast listener who is not familiar with the demon *static*, which seems to be turned loose during the summer months. Those with more experience have also noticed that certain continuous noises are audible in the receivers during various kinds of storms such as rain, snow or hail. Each series of sounds also upon investigation can be differentiated from others, so that one can tell by listening in, just what kind of a storm is going on without, even though he cannot see whether it is snowing or raining. The approach of a thunder storm is also heralded by the grindings and clicks known as static. These occur time after time during the summer months at which period the thunder storms are particularly prevalent. By a careful tabulation of the various degrees of intensity and the nature of the sounds heard it is possible to determine just what they mean.

Professor Rothé has constructed a special radio receiver consisting of a large loop aerial, a variable condenser, and a suitable series of amplifiers and detectors. The loop used is constructed in sections so that the wave-length to which the set is tuned may be varied from 1,000 to 30,000 meters. These sections are controlled by means of a switch. The variable condenser used is connected directly across the loop as in a standard radio receiving circuit.

Professor Rothé has conducted a series of investigations with this apparatus by means of which he has tabulated a series of conclusions. He has found that when static begins to get heavy he can usually count on seeing storm clouds approach on the distant horizon, and by swinging the loop through its arc he can determine the direction from which the storm is approaching. When the various settings of the loop made no difference in the strength of the received static signals it was found that a lightning storm was occurring in the vicinity of the station. It was then determined that a light, steady rain-fall would cause these sounds to disappear entirely, but a heavy rain accompanied by lightning discharges registered very well on the receiving apparatus.

Formation of dew, visitations of the aurora borealis and fogs also produced distinglishing sounds. Fogs gave a sound similar to that produced during a snow fall.

It was distinctly noticeable that lightning discharges produced a loud and distinctive signal, which could easily be recognized among all other sounds. By a careful tabulation Professor Rothé was able to determine the violence of the storm, its distance from the receiving station as well as its duration.

By means of the observations, covering a considerable period of time, the professor is now able to forecast weather conditions in an almost uncanny way. It is very seldom that his observations go wrong. He is still, however, working on this apparatus with a view of perfecting it so that the same may be easily installed in any radio station, whereupon still more accurate results will be obtained. By having these stations so equipped that they can compare notes with each other it will be found possible to get very accurate results in the forecasting of weather. It is suggested that the stations could be equipped and linked together by line telegraph in the same way that the compass stations now in use on the Atlantic coast are equipped. This latter system has proven so valuable and accurate that there is no doubt but that the results obtained in its application to forecasting would be very gratifying.

Dull-Emitting Tubes

THE electron-emitting properties of thoriated tungsten filaments were studied by Dr. Langmuir as long ago as 1914, and patents covering the use of these filaments were taken out by him shortly afterwards.

When a thoriated tungsten filament has received no special treatment, the electron emission obtained from it is approximately the same as that obtained from a filament of pure tungsten. At a very high temperature (about 2,600° C.) in thoriated tungsten a chemical reaction occurs between the tungsten and thorium oxide, resulting in the formation of a small amount of the element *thorium*, some of which remains in solution in the tungsten. Then, when the filament temperature is lowered to about 2,000° C., thorium atoms diffuse outwards from the interior of the filament and gradually form a film or coating on the surface of the filament.

WHAT ACTUALLY HAPPENS

Now, when an electron escapes through the surface of a hot filament it has to do work against the electric field at that surface, and the amount of work which it has to do is different for different substances. This amount of work happens to be less for thorium than for tungsten, so that with the same filament temperature many more electrons are able to escape from a filament covered with thorium than from one having a tungsten surface. The actual ratio of the number escaping from these two surfaces at the same temperature is about 100,000 to 1.

When employing these filaments in tubes, what we do is to reduce the filament temperature until we get the same electron emission as we normally use from a tungsten filament. We therefore save very much in the current used for heating the filament.

MUCH LONGER LIFE

For example, the tungsten filament in an ordinary receiving tube requires a voltage of 6 and a current of 1. amp., the power being 6 watts; while a dull-emitting filament of the same dimensions requires a voltage of 1.6 and a current of 0.36 amp., the power being only 0.58 watt, or less than a quarter of that for tungsten.

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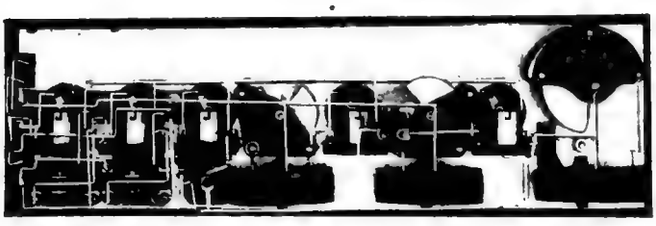
A Tuned Impedance Radio-Frequency Receiver

By HOWARD ALLEN DUNCAN



The Instruments Used in the Set Described in the Text May Be Arranged as Shown Above. This Arrangement Tends Towards Very Short Connections, and a Minimum of Capacity Effects.

The Layout on the Left Presents a Front Appearance as Shown Above. All Binding Posts with the Exception of Those for the Antenna and Ground Are Located at the Right-Hand End.

RADIO-frequency amplification of signals is a subject which is comparatively recent. The amplification of radio signals at audio frequencies was an accomplished feat a little after the invention of the three element vacuum tube, but it was not until years after that radio-frequency amplification was experimented with.

The effect of radio-frequency amplification is to amplify weak electrical impulses *before* they are detected. This is really the same thing as if the transmitting station is moved so much nearer the receiving station, for the voltage impressed upon the grid circuit of the detector tube will be greater in either case. Hence, the effect of this type of amplifier is to make audible signals to which the detector alone is unresponsive.

There are three general types of radio-frequency amplifiers: transformer coupled amplifiers; resistance coupled amplifiers, and finally, tuned impedance coupled amplifiers. All of these types have, of course, their relative merits. The simplest of all types is undoubtedly the resistance coupled, but, unfortunately, it has a very low amplification factor, and is rather wasteful of plate current. The transformer coupled circuit is probably the most popular form today. It has this disadvantage, however, that the range of maximum amplification by the coupling transformer is limited by the frequency for which it was designed. By using iron cores, and resistance wire for the windings, the range of amplification is increased to some extent, but generally speaking, transformer coupled circuits work poorly on the lower wave-lengths.

With the advent of legislation which will reduce the wave-length allotments of the broadcasting stations, and also that of the operating amateur, it is very necessary that a good and efficient type of radio-frequency amplifier be used. In the near future, many broadcasting stations will be operating on a wave-length of from 221 to 300 meters, and amateur activities will be limited between the band of wave-lengths included from 150 to 220 meters.

A type of coupling between radio-frequency steps which allows comparative ease of tuning even on the shorter wave-lengths is the impedance type. The tuned impedance circuit is comparatively new to the average amateur in this country, although it has been in use in France, England and other European countries with great success.

Although it has many shortcomings, its main advantage lies in its ability to tune sharply. With stations operating about 2 or 3 meters apart, this feature will be appreciated by the amateur and the broadcast fan as well. The principle upon which this circuit works will be easily understood.

Picture an ordinary transformer-coupled radio-frequency amplifier circuit. Remove the transformer entirely, and connect the plate circuit of one tube to the grid, or input circuit of the next one. Do this with the filament-grid circuit of these two tubes. Now place an inductance shunted with a condenser between these two distinct circuits, and a tuned impedance coupled radio frequency amplifier results.

As is well known, in a series circuit, the impedance is zero at resonance. However, in a parallel circuit, such as is used in the tuned impedance circuit, the impedance to alternating currents is infinite at resonance. However, the ohmic resistance of the coil in circuit remains constant to the d. c. furnished to the plate circuit. In fact, it is only equal to a few ohms, and thus the full "B" battery potential can be applied to the plate circuit, which gives correspondingly louder signals in the phones.

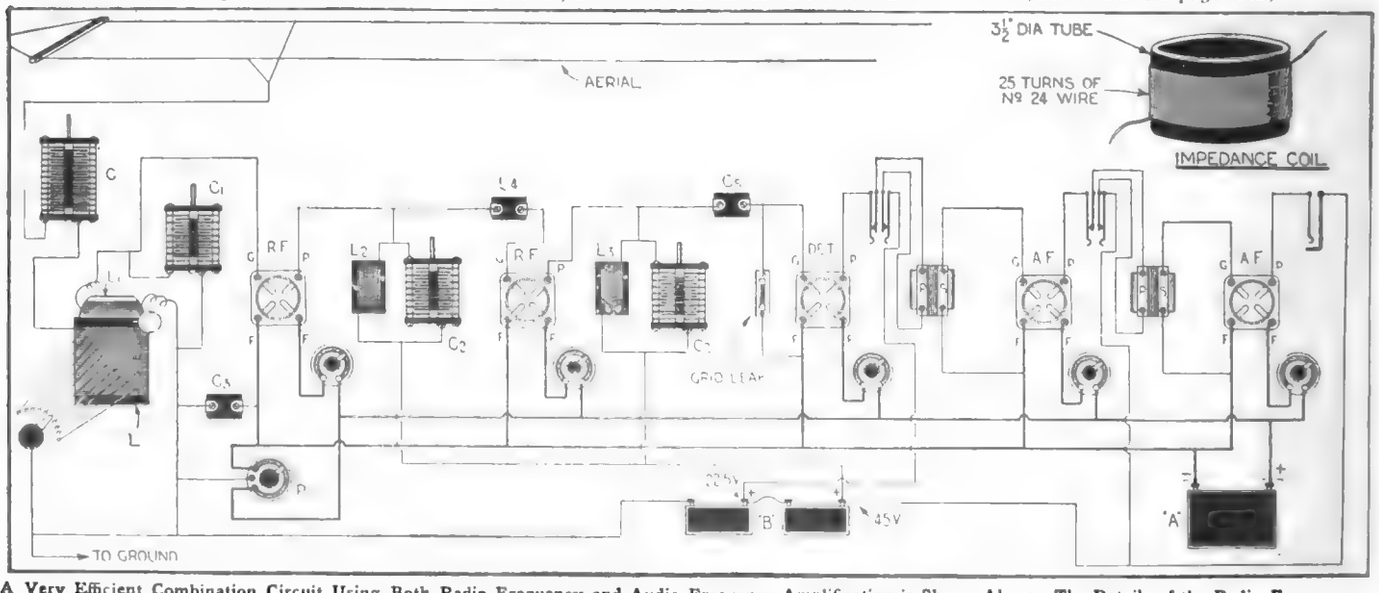
The construction of an amplifier making use of a few steps of tuned impedance amplification is not difficult. It really reduces itself to the design of the correct size of coils and the right capacity for the condensers which will be used to couple one step to the succeeding one.

Work should first be started on the coils. As this will be a two stage radio, detector, two stage audio frequency receiver, two sets of impedance coils will be necessary for the two first radio frequency amplifiers. The windings L-2 and L-3 are similar, and consists of thirty turns of number 24 single silk covered wire on a tube 3½ to 4 inches in diameter, for each coil. Bakelite tubing, cut in lengths of about one inch, is the best to use. The winding may be shellacked slightly at the beginning and end of the coil, so as to keep the wires in place. The shellac should have been thinned down with alcohol, and should not be applied to the entire coil.

The coil L is the primary of a variocoupler. Winding L-1 is the secondary to the variocoupler, and is shunted with a variable condenser of 0.0005 mfd. capacity for tuning the secondary circuit.

Each impedance coil is shunted with a variable condenser having a capacity of 0.0005 mfds. each. They should be equipped with vernier adjustments, as the tuning of these circuits is very critical. The rest of the circuit is similar to the familiar detector, and two stage audio frequency amplifier layout, and will not be further explained.

(*Continued on page* 302)



A Very Efficient Combination Circuit Using Both Radio Frequency and Audio Frequency Amplification is Shown Above. The Details of the Radio Frequency Impedance Coupling Coil Are Given in the Upper Right-Hand Corner.

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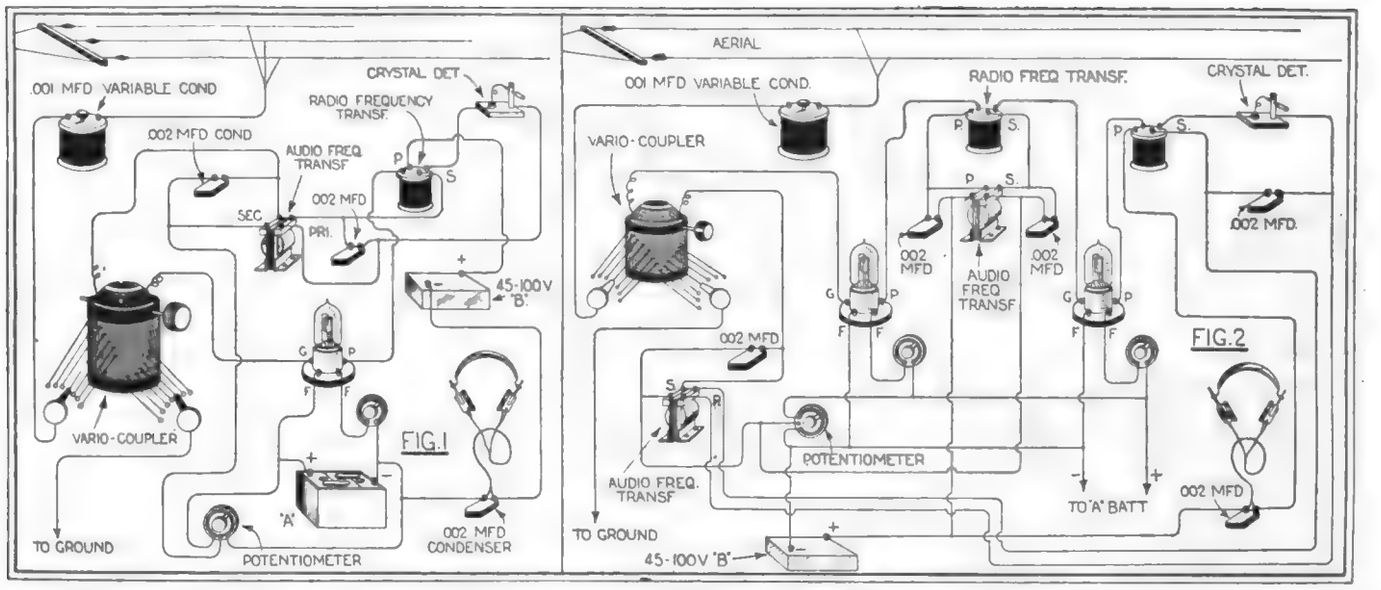

Fig. 1 Shows the Circuit Diagram for a One-Tube Reflex Circuit Employing aCrystal Detector. This Circuit Gives the Effect of One Stage of Radio Frequency, Detector, and One Stage of Audio Frequency Amplification. Fig. 2 Shows a Two-Tube Reflex Circuit Giving the Effect of Four Tubes. A Crystal Detector is Used in These Circuits Because of Its Excellent Rectifying Properties.

Reflex Circuit Saves Tubes

By A. P. PECK

ONE of the most versatile of all instruments, regardless of their field of operation, is the audion or vacuum tube. It has proved its worth time and again in the radio field as well as in the electrical laboratory. Without it our great broadcasting stations, our long distance receiving sets, our sensitive amplifiers of weak electrical impulses upon which transcontinental telephony depends, all would be impossible.

Within the last few years another possibility of this modern marvel has been developed and recently brought to the attention of the radio public. This is what is known as the *reflex method* of receiving radio telephone and telegraph messages. This method in the main, causes the vacuum tube to perform two distinct functions at virtually the same time, which is accomplished by *feeding back* the impulses from the last tube to the first one, whereupon they are amplified again.

This process must not be confused with the *regenerative feed-back*, as the latter is entirely different. The term is used in connection with the reflex in lieu of a better one. In the ordinary familiar regenerative feed-back circuit, the plate current is fed back through a coil inductively coupled to the grid circuit, thereby inducing a larger current in the latter. This, in effect, reduces the resistance of the grid circuit as the coupling is varied, to such an extent that the tube starts to oscillate and produce sustained oscillations. Just before the oscillating point is reached a current greater than normal flows in the grid circuit and the result is a correspondingly larger flow in the plate, and consequently in the phone circuit. If the tube is allowed to break into oscillation, the set will not function properly.

The phenomena, however, is not present in the reflex circuit as the action taking place is on an entirely different principle. Here the current, considering the one tube circuit illustrated in Fig. 1, is first amplified at radio frequency by the tube, is rectified by the crystal detector and then led back through the audio frequency transformer to the grid circuit of the tube. Here it is now amplified at audio frequency by the same tube, and rendered audible by the telephone receivers.

Glancing at Fig. 1, the first question that arises is, why does not the current affect the phones after it is amplified at radio frequency, and before it reaches the detector? This is easily understood when it is realized that radio frequency current will not pass through a high impedance coil with an iron core such as the windings of the phones. It is therefore provided with a path through the by-pass condenser across the phones.

The potentiometers shown in all the circuits are absolutely necessary to keep the tube or tubes as the case may be, in a stable state and not oscillating. They serve to

(*Continued on page 290*)

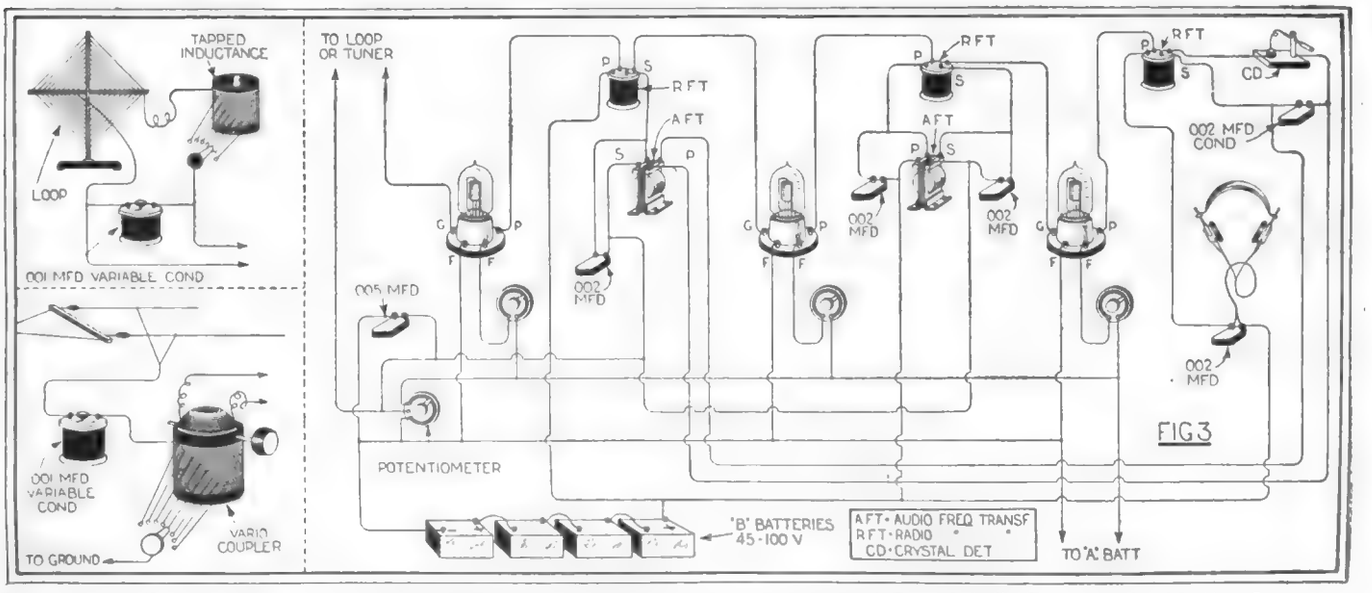

Fig. 3. Shows a Three Tube Reflex Circuit Giving the Effect of Three Stages of Radio Frequency and Two of Audio Frequency Amplification Connections, for Either Tuner or Loop Are Shown in This Figure.

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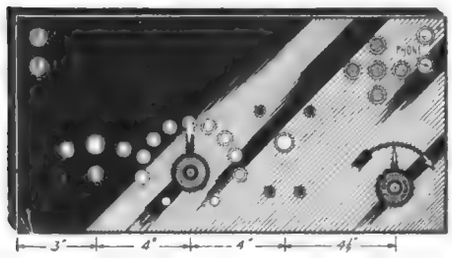
A Short and Intermediate Wave Regenerative Receiver

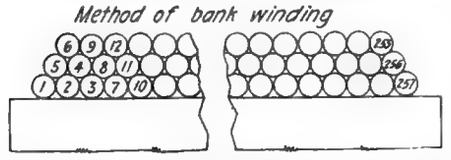
By JOSEPH SCHUCK

THE receiving set to be described in this article is neither novel nor does it incorporate any new feature. The description was written in a modest endeavor to meet the demand for data and details of a 200-3000 meter receiver.

It would be well to obtain the necessary



A Front View of the Panel of the Receiving Set Described in the Text is Shown Above. Some of the Measurements Are Given Thereon.



Bank Winding is Accomplished by the Method Shown Above. The Numbers Refer to the Turns of Wire.

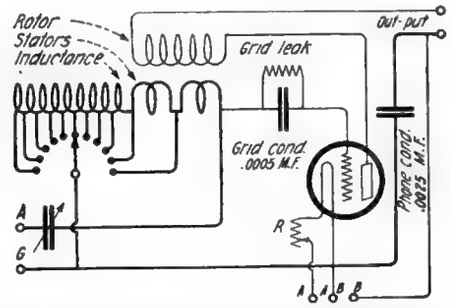
material as the first step in the construction. The following parts should be secured; some of them may be made at home by following instructions given in previous articles.

1 panel of good insulating material 17" long, 7" high and ⅛"-3/16" or ¼" thick.
½ lb. No. 24 double cotton covered magnet wire.
1 large size variometer.
1 tube of Bakelite or cardboard 4" in diameter and 4" long.
1 43-plate variable condenser.
1 socket and rheostat.
1 small panel 3"x5"x⅛" or $\frac{3}{16}$".
7 binding posts.
1 grid leak and condenser.
Brass strip, machine screws, connecting wire, cambric tubing, etc.

By referring to the diagram the position of the variometer and inductance will be noted. The inductance is wound in three-bank form with 86 turns in each layer, a total of 257 turns and is tapped after the completion of the winding. The taps (counting only the top layer and not figuring in the other two layers) are taken at, 3, 8 and every 8 thereafter, counting from the variometer end.

It will be necessary to cut one connection in the variometer, the one where a rotor lead is soldered to one of the stator ends. The variometer stator is tapped, the rotor ball being connected in the plate circuit to provide regeneration.

Mount the inductance tube on the variometer with small brass angles. The variometer, in turn, is secured to the panel by means of brass strips or directly with wood screws. Make all the tap connections to the switch points and mount the variable condenser. The small panel holds the tube socket and three binding posts for filament and plate battery connections. It is fastened to the panel by means of brass angles. As a precautionary measure, to prevent body capacity, it would be advisable to place a sheet of either aluminum, copper or tinfoil in front of both the condenser and variometer. The metal sheets may be 4"x5". Care must be taken that none of the metal parts of either instrument touch the shields. Connections are made with stiff wire run in bus-bar fashion or in cambric tubing. All



The Circuit Diagram for the Excellent Regenerative Receiver Described in the Text Shown Above.

leads should be soldered or else a good mechanical connection made. Descriptions of banked-windings have appeared in RADIO NEWS and it would be well to read them. The general fault is found in making bends. They should be made at right angles so that a sharp, firm bend will result.

In operating this receiver, a vernier rheostat would be of service. The type employing carbon under pressure will be suitable. If care is taken in the selection of the apparatus and neat wiring and soldered connections are made, the completed set will prove a source of constant pride to the owner. The ease of control is marvelous. two knobs providing variation of the entire wave-length.

Making Radio Receivers

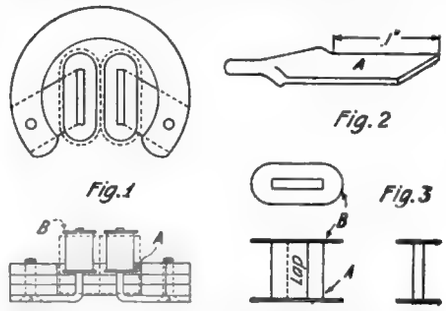
By H. CLAUSEN

IT is possible to make a set of radio receivers at very little cost by using a pair of ordinary telephone receivers. Either the long type, as used on desk telephones, or the flat type used by switchboard operators and on small private house phones can be used; the latter is of course to be preferred, as it makes the neatest and most compact head set.

Telephone receivers are usually wound with just enough wire to give them about 75 ohms resistance. For good work a radio receiver must have at least 1,000 to 1,500 ohms resistance. Our problem then is to replace the 75-ohm coils with coils that will give preferably 1,500 ohms. Fig. 1 shows the magnet and pole pieces of a 75-ohm flat type telephone receiver. The regular coils must be removed and the ones which we are to make must be as large as possible, (see dotted lines). If there is a metal washer at the bottom of the coil, as indicated at "A," remove this entirely and discard it, but save the washer "B" that fits on top of the coil, as this must be replaced over our new coil.

Out of soft pine wood, whittle an arbor, Fig. 2. The tongue "A" is made about 1" long, and the same width and thickness as the pole piece in Fig. 1. The end "B" is made round and in line with the center of "A." This end will later be used to hold the arbor in a hand drill or small lathe for winding the coil.

The spool on which the wire is to be wound is shown in Fig. 3. Four will be required for a double head set. The body, part "A," is made of one layer of heavy glazed paper lapped about 3/16" on one side and glued. The end pieces, "B" are



Various Steps in the Reconstruction of Radio Receivers Are Shown Above. Fig. 2 Shows a Form for Holding the Winding, While Fig. 3 Gives the Construction of the Winding Form.

made from a 3"x5" file card and are slipped over the body "A" and glued into place by using an extra heavy fillet of glue in the corners. After the glue has dried thoroughly, slip the spool over the arbor and coat all over with shellac. This should be allowed to harden for 24 hours and another coat of shellac applied. If possible, bake the spools for half an hour in a warm oven.

About 2 oz. of No. 40 enameled copper wire will be needed for the coils. Only about 1½ oz. will be used, but if a breakage occurs some will be wasted. This amount of wire wound on the four coils of the two receivers will give about 3,000 ohms resistance and the finished set will compare well with the regular 2,000 ohm manufactured ones. If a small lathe is available that can be run at a slow speed, the wooden arbor can be chucked, the shellacked spool slipped over it and the winding done in a short time. The number of turns should be carefully counted with a mechanical revolution counter or a speed indicator and each spool should have practically the same number.

If no small lathe is available, a hand or breast drill will do if it is clamped solidly in a vise or other holding fixture. The wire is wound clockwise on all four coils.

After a pair of coils have been assembled on the pole pieces of the receiver, solder the two "lead-in" or starting wires together and bring the outer ends of the coils to the binding posts in the receiver case, and solder. The two receivers are connected in series and can be tested by short circuiting across a single dry cell. To make the receiver as sensitive as possible, carefully file off the top of the case until the diaphragm rests within about 1/64" of the top of the magnets or pole pieces. The diaphragm, however, must not touch the pole pieces under any circumstances.

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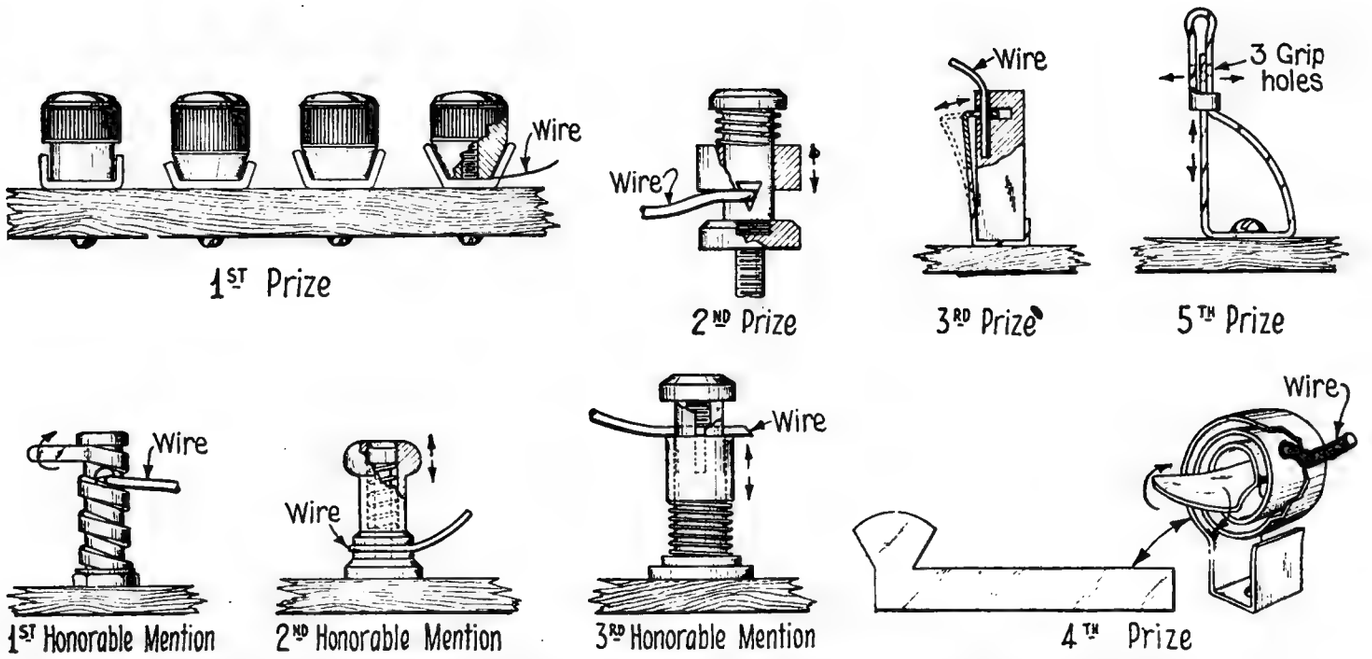

The Above Diagrams Show the Constructional Details of the Various Prize Winners and Honorable Mentions in Our Simplest Binding Post Contest. The Arrows Indicate in Which Direction the Working Parts of the Various Posts Are to Move.

"Simplest Binding Post" Prize Awards

WELL, ladies and gentlemen, it is all over. What is? Why the Simplest Binding Post Contest, of course. Out of some 6,922 entries, the judges had to decide upon five prize winners and the task was so great that it was finally decided to award three honorable mentions as well.

Some of the entries were extremely ingenious and the models submitted were well made, but the posts were so complicated, that this feature alone eliminated them from consideration in this contest. As stated in the announcement the simplest and most efficient post was desired. A great many attempted to use spiral springs in places where they would easily be broken or bent completely out of shape. Others made use of bent wire forms which were designed to hold the wire but could not be made to do so without the aid of a hammer or some other similar weapon for pounding them together. Some of the contestants entered models, which was by far the best course, for it enabled the judges to quickly decide upon the practicability of the article.

Of all of the prize winners there was only one, namely, the second prize winner, who did not submit a model.

Prize Winners

FIRST PRIZE

$50.00 in gold, Mr. J. H. Bolton, 394 Beaconsfield Ave., Montreal, Canada.

SECOND PRIZE

$20 00 in gold, Mr. Ansel Stewart Wysong, Jr., Mead, Kansas.

THIRD PRIZE

$15.00 in gold, Mr. Carl Ringchap, 220 Golden Gate Ave., San Francisco, Calif.

FOURTH PRIZE

$10.00 in gold, Mr. Olin A. Williams, Americus, Georgia.

FIFTH PRIZE

$5.00 in gold, Mr. Jack Ellsworth, 1318 New Jersey Ave., Kansas City, Kansas.

FIRST HONORABLE MENTION

Mr. Paul F. Bryant, Livermore Falls, Me.

SECOND AND THIRD HONORABLE MENTIONS

Mr. Arnold Mountfort, 118 W. Adam St., Los Angeles, Calif.

FIRST PRIZE WINNER

Mr. J. H. Bolton submitted excellent mechanical drawings and well made models of his binding post or rather several binding posts and the underlying idea was so very simple, yet efficient, that the judges awarded it the first place. As will be seen it consists of a form very similar to the ordinary binding post, but there are edges turned up at the base cup-fashion, which feature allows the cap to be tightened securely without the wire slipping out from under it.

SECOND PRIZE WINNER

Mr. Ansel Stewart Wysong, Jr., did not submit a model but entered an excellent mechanical drawing showing all the different parts of his entry. By referring to the diagram above it will be seen that the post is to be operated by placing the thumb on the top and clasping the sliding ring between the first and second fingers. The ring is then pulled up and the wire inserted in the V-shaped slot. Upon releasing the ring, the spiral spring forces it down against the wire, clamping the latter securely. The V-shaped slot allows the use of any size wire such as is ordinarily employed in electrical or radio work.

THIRD PRIZE WINNER

The model submitted by Mr. Carl Ringchap consists of three parts, an upright standard, a strip of spring brass and a machine screw. A hack-saw, a drill and a tap do all the work necessary. As will be seen from the drawing it is only necessary to compress the flat spring with the thumb and forefinger thereby allowing the insertion of the wire through the holes thus lined up. The wire is thus held securely. It is advisable to make the hole in the flat spring somewhat pointed at the side nearest the standard so that a better grip may be secured on the wire.

FOURTH PRIZE WINNER

Mr. Olin A. Williams submitted the most elaborate model entered into this contest. He uses a novel method of clipping the wire by means of a spiral made of spring brass, constructed as shown in the diagram. To use, the spring is rotated by means of the knob provided until the holes line up. The wire is then inserted in the holes and the spring released whereupon the wire is securely fastened.

FIFTH PRIZE WINNER

A novel idea in a flat spring binding post originated by Mr. Jack Ellsworth is shown in the illustration. The whole thing is constructed from a single strip of spring brass bent to the shape shown. Holes are drilled so that they are out of line when the post is at rest, but line up when the top of the post is pressed down. Upon doing this the wire is inserted in the holes and the top of the post released.

FIRST HONORABLE MENTION

A model submitted by Mr. Paul F. Bryant was considered by the judges to be worthy of first honorable mention and an illustration of it is shown above. It consists of an upright and a rotatable spiral of stiff brass. Upon inserting the wire in the hole provided and turning the spiral either to the right or to the left, the wire is gripped securely.

SECOND AND THIRD HONORABLE MENTION

Great ingenuity was shown by Mr. Arnold Mountford in constructing his models which can be plainly seen above. Spiral springs furnish the holding power in both of these posts and the method of using the same may be plainly seen by referring to the illustrations.

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THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to the department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

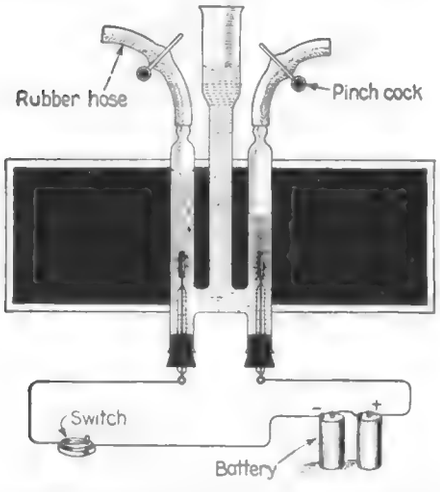
ELECTROLYSIS

(1487) G. C. Greenberg, Gary, Indiana, asks:

Q. 1. What is the best way to decompose water by electricity in the laboratory so as to obtain hydrogen and oxygen?

A. 1. The most efficient apparatus for decomposing water in small quantities is that known as the Hoffman apparatus and is illustrated herewith. A battery of anywhere from 3 to 6 volts may be used with this apparatus.

The apparatus consists of three upright glass tubes. The center one has a funnel shaped top, and the two outside ones are drawn out to tips, to which rubber hose may be attached. The three tubes are all connected together at the bottom, and in the two outside tubes are sealed wires leading to small electrodes which are situated at ¼ of an inch from the bottom of the tube. These electrodes are usually made of platinum foil. Rubber tubes are attached to the tips, and the apparatus is filled with water through the funnel shaped center tube. Clips are now put on the rubber tubes to prevent the escape of gas, and the two wires projecting from the bottoms of the outside tubes are connected to the source of current. Gas will begin to form at both of the electrodes and bubbles will rise to the top of each tube. It will soon be noted that twice as much gas is formed in one tube as in the other. This gas is the hydrogen and the smaller quantity is the oxygen. When the required amount of each of the gases has been collected, it may be drawn off through the rubber tubes provided for this purpose.



An Effective Type of Electrolysis Apparatus Fitted With Pinch-Cocks To Control the Flow of Gas From the Positive and Negative Gas Generating Chambers.

A PROBLEM IN CENTRIFUGAL FORCE

(1488) D. McGovern, Detroit, Mich., asks:

Q. 1. When a car turns a corner so fast that it moves on two wheels, will the inside or the outside wheels leave the pavement?

A. 1. When a car turns a right hand corner, on a level road going at such a speed that it turns on two wheels, the right hand wheels leave the ground, and the car travels on the left hand or outside wheels. This is true in all cases. The writer discussed this subject with several authorities, and this is the consensus of opinion of all of them.

Q. 2. Does a hunter in going around the tree trying to get a shot of a squirrel which just keeps on the opposite side of the tree from him go around the squirrel also?

A. [illegible] a hunter is going around a tree try[illegible] shot at a squirrel which keeps ahead of him just out of range of the gun, the hunter goes around the tree and also around the squirrel.

REDUCING SILVER CHLORIDE

(1489) John J. Muller, Brooklyn, N. Y., wants to know:

Q. 1. How may I reduce silver chloride to metallic silver?

A. 1. Add to a solution of water and sulphuric acid, 50% of each, some metallic zinc and then introduce the silver chloride. Metallic silver will be formed and the zinc will be dissolved completely if enough acid is added. If some lumps of zinc are left they can be picked out after washing the silver.

THALOFIDE CELL

(1490) Lawrence Lynch, Yakima, Wash., wants to know:

Q. 1. What is the action of a thalofide cell when exposed to light?

A. 1. The electrical resistance of a thalofide cell is very high when in the dark, but decreases to a marked degree when exposed to the light, and therefore it allows a greater amount of electricity to pass through it when exposed to the light, than when in a dark place. It has no lag.

IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

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THE TELEGRAPHONE

(1491) Billy Cleaveland, Durant, Okla., says that he is intending to do some experimental work with the telegraphone, but would like to have some information on the same before going into this work. He asks:

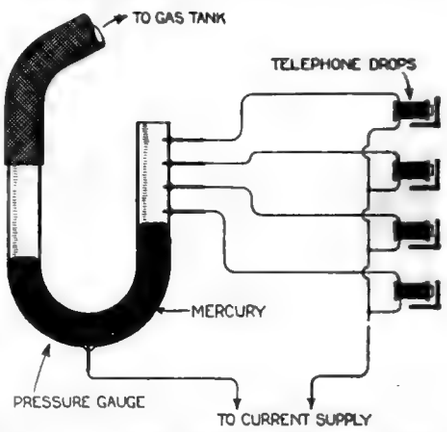
Q. 1. In the recording of this instrument would not a certain amount of noise be produced on the steel wire due to the imperfection of the transmitter? If so would not a condenser transmitter do away with this noise?

A. 1. There would no doubt be a certain amount of noise in the reproduction of voice and music from the telegraphone due to the imperfections in the carbon grain transmitter. However, there are various types of carbon ball transmitters on the market which operate with practically a minimum of distortion and noise.

Undoubtedly, the condenser transmitter that you mention would give even less noise than the above mentioned one, but this type is still in the experimental stage, and we doubt very much if it would be possible for a private individual to obtain one of the same.

PRESSURE GAGE

(1492) Hugo Muri, Charlestown, W. Va., says that in connection with a factory there is a high pressure gas plant at a distance of seven miles away. It is necessary that the pressure being supplied by this gas plant be known at the office of the factory constantly.



As the Gas Pressure Rises It Causes the Mercury In the U-Tube To Be Pushed Upward Past the Successive Contact Wires Shown, Actuating Consecutively the Various Telephone Drops Containing Numbers, Which Thus Shows the Pressure of the Gas At Any Distance Desired.

Q. 1. How can electricity be applied to this project so that the pressure at the gas station can be ascertained at any time in the office of the factory?

A. 1. At the gas works you might have a specially constructed mercury gauge consisting of a U-shaped tube with wires sealed into the glass at certain distances apart on the tube. Any expert glass blower can do this job for you. The number of wires to have sealed in the tube will depend upon how close you wish your readings to be. One wire will be sealed into the tube at the bottom of the bend, and a common connection made thereto. The lowest wire of the series will be at a point where you wish the lowest reading to show in the office.

Now obtain from any telephone manufacturing company a set of telephone drops, and connect them as shown in the diagrams. The battery will have to be of the strength specified for use with the drops you purchase. The number of drops will correspond with the number of wires sealed into the tube at the factory.

The action will be as follows: When the mercury rises in the tube due to the increasing gas pressure, to the first contact, it will close the circuit for the first telephone drop, thereby registering in the office. When the mercury hits the second contact, the second drop will register, etc.

GENERATOR QUERIES

(1493) Joseph Lubic, McKees Rocks, Pa., asks:

Q. 1. What horse power will a motor have to have to drive a generator having an output of eight volts and ten amperes?

A. 1. Allowing for all losses, you should use at least a one-fourth horse-power motor to drive your generator.

Q. 2. Where does a generator without permanent magnets get its magnetic field from?

A. 2. If the field of your dynamo does not have permanent magnets, and the armature has absolutely no residual magnetism, it will be necessary to excite the field with an external battery to start the field to building up. However, there is generally a certain amount of residual magnetism in the field frame, which allows the generator to build up.

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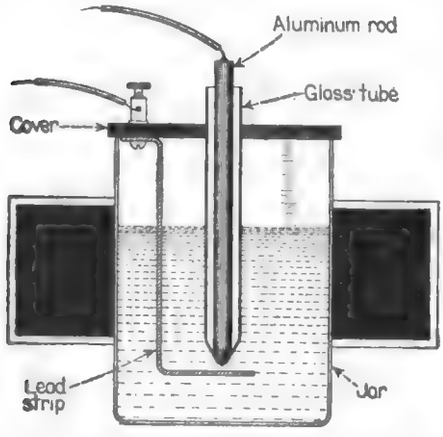
ELECTROLYTIC INTERRUPTER

(1494) Fermin Padron, Havana, Cuba, asks:

Q. 1. Can you give me sufficient information to enable me to construct an electrolytic interrupter?

A. 1. A diagram is given herewith, showing the construction of an electrolytic interrupter. All dimensions are variable to suit the builder. The glass jar may be an ordinary fruit jar, and the cover may be of wood, impregnated with paraffin. The electrolyte should be in proportion of about one part of sulphuric or hydrochloric acid to 20 parts of water. It will be necessary, however, to experiment to find the exact proportions. The distance between the point of the lead rod and the aluminum rod, should be about ¼ to ½ inch, but the absolutely correct distance must be determined by experiment. If you can get a glass tube which will just fit very closely over the aluminum rod, it will not be necessary to draw out the tube as shown in the sketch. One connection is made to the lead strip, and the other to the aluminum rod, and the interrupter is connected in series with one side of the coil, the key being connected in series with the other side. In all cases, it is advisable to connect two 1 M.F. condensers in series and shunt them across the primary of the coil, the central point being connected to the ground through a fuse, as a kickback preventer.



Above Are Shown the Constructional Details of An Electrolytic Interrupter. This Interrupter Is Very Efficient When Used With a Radio Transmitting Transformer. It Provides a Very Heavy Spark of Constant Frequency On the Secondary Side of the Coil.

CHLORIDE OF SILVER

(1495) The Little Falls Plating Co., Little Falls, N. Y., wants to know:

Q. 1. Can you give me a formula for making chloride of silver?

A. 1. Chloride of silver may be made by precipitating a hot solution of silver nitrate with dilute hydrochloric acid.

RESIDUAL MAGNETISM

(1497) E. E. Littleford, Los Angeles, Cal., asks:

Q. 1. Will a particle of matter, say a drop of water discharged through a magnetic field, such as that provided by a permanent magnet, receive a charge so that when it leaves the influence of the field it will still have a certain amount of residual magnetism?

A. 1. Since a drop of water is non-magnetic, it would not retain a magnetic charge after passing through a magnetic field, such as that provided by a permanent magnet. If a piece of iron or steel could pass through the magnetic field of a permanent magnet, without being attracted to either one or the other of the poles, it would probably retain a slight magnetic charge after leaving the field. The steel would retain the greater charge.

HARDENING ALUMINUM

(1498) George Lamotte, Brooklyn, N. Y., asks:

Q. 1. Can aluminum be hardened?

A. 1. Aluminum can easily be hardened. This is done by merely adding a small quantity of copper or nickel to the metal.

MAGNET DATA

(1499) Joe Lanay, Lamona, Wash., wants to know:

Q. 1. Will you give me the size of core and the size and number of turns of wire for the magnets of a large gong to be operated on 32 volts D. C.?

A. 1. Presuming that you wish to use a double pole magnet, we would suggest that the core for each pole be 1 inch in diameter by 6 inches long, connected together by a yoke 4 inches long, thereby allowing 2 inches space between the core. On each core wind 5 layers of No. 16 D. C. C. wire, and connect the 2 coils in series. Of course, we presume that you will fit the cores with suitable fibre ends. These magnets will pass approximately 4 amperes.

GRAVITY CELLS

(1500) Charles Luckert, Jr., New York City, asks:

Q. 1. What is the voltage of a gravity cell?

A. 1. The voltage of a gravity cell varies from 1.07 to 1.4. When first set up, the internal resistance is high, but by short circuiting the cell for an hour or so, the resistance is reduced, and the cell is ready for use.

Q. 2. How can the evaporation of the electrolyte be prevented?

A. 2. To prevent evaporation, a layer of some kind of mineral or paraffin oil should be placed on the top of the solution.

Q. 3. Could sheets of copper and zinc be used in place of the regulation crows' feet?

A. 3. You can use sheets of copper and zinc as you suggest.

Q. 4. How can the two solutions be kept from mixing?

A. 4. After setting up the cells, they should not be moved around, as otherwise the two liquids will become mixed. To prevent the copper sulphate wandering to the zinc plate, the cell should be kept in a closed circuit of considerable resistance when not in ordinary use. This is to allow it to keep sending out a weak current at all times and is of course wasteful. The line of separation between the copper and zinc sulphates, or the "blue line," should be about half way between the two electrodes.

Hook-up Number of Radio News:

This is a special number prepared for the benefit of the experimenter who likes to dabble in a myriad of different connections and hook-ups. It will be a treat for every Radio Bug.

List of Articles in the July Issue of Radio News

NEW ALPHABET FOR RADIO AND LAND LINES By Gen. Geo. O. Squier

A NEW SYSTEM, WHICH SAVES MUCH TIME IN SENDING MESSAGES BY RADIO OR ANY OTHER MEANS OF COMMUNICATION.

THE FLAME MICROPHONE By Dr. Lee de Forest

A NEW DEVICE WHICH REPRODUCES ALL FREQUENCIES WITHOUT ANY DISTORTION.

A NEW SYSTEM OF RADIO CONTROL By Capt. H. W. Webbe

HOOK-UPS

SEVERAL PRACTICAL CIRCUITS FOR THE RADIO EXPERIMENTER. AN INSIDE VIEW OF THE COMPLETE SET IS SHOWN, WITH EACH CIRCUIT.

A NEW SINGLE-TUBE REFLEX RECEIVER By Clyde J. Fitch

RADIO FREQUENCY AMPLIFICATION TO THE NTH DEGREE By S. R. Winters

NEW DEVELOPMENT IN TUBES

PRACTICAL RADIO SLIDE RULE By Ralph Batcher

SOAP FORMULAS

(1501) Leo Lynch, Denver, Colo., inquires:

Q. 1. Can you give me a formula for a shampoo whose ingredients are not injurious to the hair?

A. 1. We are giving you herewith a formula for a liquid shampoo.

Fluid extract of soap bark	10 parts
Glycerin	5 "
Cologne water	10 "
Alcohol	20 "
Rose water	30 "

Q. 2. Kindly give a formula for a good carbolated soap?

A. 2. This may be made as follows:

Cotton seed oil	200 parts
Alcohol 91%	300 "
Water	325 "
Caustic soda	45 "
Potassium carbonate	10 "
Ether	15 "
Carbolic acid	25 "

All parts are by weight. The oil is mixed in a large bottle with water, 100 parts; alcohol, 200 parts; and caustic soda, 45 parts, and after saponification the remaining alcohol and the potassium carbonate dissolved in the rest of the water, and finally the carbolic acid and the ether are added and the whole is well shaken. The mixture is poured into bottles, tightly corked and stored away in a place where the temperature is medium and constant.

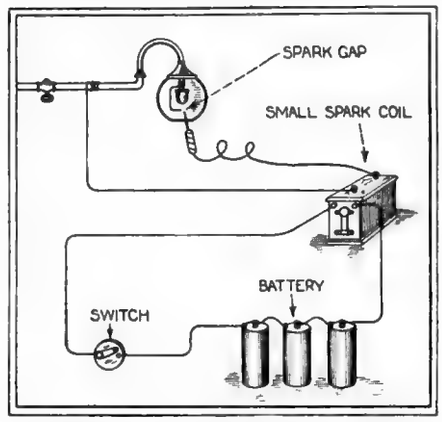
A carbolic soap may be very easily made by using a suitable soap body, and adding thereto a small quantity of carbolic acid. Add only a little.

LIGHTING GAS BY ELECTRICITY

(1502) Rayfield Geer, London, Madison Co., Ohio, asks:

Q. 1. How is it possible to ignite a gas light by means of an electric spark?

A. 1. The best way to light gas by means of electricity is to obtain a small spark coil and connect the primary of it in series with a battery and switch. Connect one side of the secondary to the metal gas pipe, bending the wire around under the mantle as shown in the accompanying diagram. Connect the other terminal of the secondary to a well insulated handle from which projects a metal point, which metal point is connected to the other side of the secondary. Bring the two points close together as shown in the diagram, close the switch and allow sparks to pass between the points. Now turn on the gas and it will ignite.



One Method of Lighting a Gas Fixture By Electricity Is Clearly Shown Above and Fully Explained In the Text.

LIQUIFYING AIR

(1503) Herbert Martin, Fruitland, Idaho, asks:

Q. 1. How is air liquified?

A. 1. Air is liquified by submitting it to very great pressure, and at the same time providing a way of taking up the heat which will be given off, due to the very great pressure and reducing its temperature far below 0° F.

SHELLACKING CORKS

(1504) J. E. Norton, 477 South Front Street, Memphis, Tenn., says that he wants to shellac 500 to 1,000 straight side cork floats per day so as to give the best service when constantly submerged in gasoline. He asks:

Q. 1. What kind of shellac is best for this purpose and how should it be applied?

A. 1. We would suggest that you use a good quality of orange shellac dissolved in pure alcohol. It is advisable to apply this in vacuum, but a machine for that purpose would have to be designed especially for your purpose.

Q. 2. What is the best method of placing figures on aluminum tubing so that they cannot wear off and so that gasoline will not remove them? They should be black.

A. 2. Stamping numbers in the drawn aluminum tubing, or electrically etching the numbers in this tubing, is about the best method you could use for your figures.

We would suggest that black asphaltan be employed to fill in the stamped numbers, and a coating of shellac added outside of this.

Q. 3. What solution will brighten up the finish of pewter and galvanized iron when dipped into it?

A. 3. Washing pewter or galvanized iron with dilute hydrochloric acid will clean the material, but should only be used in extreme cases; it will not give it a very fine finish. Buffing the same is the best procedure.

CHANGING THE COLOR OF HAIR

(1505) C. B. Morris, Santa Barbara, Cal., wants to know:

Q. 1. Can you give me a formula by which any color hair can be turned white without injuring the skin.

A. 1. Any method of changing the color of hair is generally conceded by specialists to be injurious to both the hair and the skin. We would not advise you to try anything along this line.

A common method in use among women to bleach the hair on the arms [illegible]ther than to remove it entirely, is to bat[illegible] occasionally with peroxide. This eff[illegible] the hair [illegible] that it becomes pra[illegible]

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How Our Navy Shoots Over the Horizon

By GRASER SCHORNSTHEIMER

(*Continued from page* 221)

only three of America's ratio of eighteen capital ships, the battleships *Maryland, California* and *Tennessee,* can elevate their guns to fire more than 25,000 yards. Fine new ships like the electrically driven *New Mexico* would be powerless to fight even a much smaller and older ship, like the British *Queen Elizabeth,* and there are five like the *Queen.*

In order to bring our ships up to the efficiency of British and Japanese vessels, it will be necessary to increase the angles of elevation of their turret guns. It will also be necessary to give them new fighting tops from where their fire can be controlled. It is estimated that this modernization will cost $6,500,000. Congress appropriated this sum, but due to an attempt of the British to get us to forego this modernization, the Secretary of the Navy has decided that Congress must reappropriate the money before it can be expended.

The British evidently claim that the Naval Treaty formulated at the Washington Arms Conference forbids such modernization. The British do not officially claim this. They merely hint it, because their ambassador as well as every other fair-minded Britisher knows full well that the Naval Treaty specifically provides for just such modernization. The clause of the treaty referring to this is quoted below, the italics are my own to emphasize the clearness of the treaty in providing that such modernization may be done by any nation.

"No retained capital ships or aircraft carriers shall be reconstructed except for the purpose of providing means of defense against air and submarine attack, *and subject to the following rules*: The contracting parties may for that purpose equip existing tonnage with bulge or blister or anti-air-attack deck protection, providing the increase of displacement thus effected does not exceed 3,000 tons displacement for each ship. No alteration in side armor, in caliber, number *or general type of mounting of main armament* shall be permitted." (Ch. 2, pt. 3, sec. I, par. D, Naval Treaty.)

Admiral Charles B. McVay, Chief of our Naval Bureau of Ordnance, said before Congress, "The increased elevation is not a change in the general type of mounting being merely a modification of existing mounts." This is proof of the fact that the proposed modernization does not violate the Naval Treaty. President Harding, Secretary Hughes, Secretary Denby, Secretary Weeks and other cabinet officers are known to be highly in favor of this modernization. Congressman Madden and various other members of Congress are known to be wildly opposed to it on economy grounds. But they are basing their arguments against the treaty on the British attempt to make the modernization seem a violation of the Naval Treaty and trusting to the parsimony of Congress to get it across.

Speed

By HAROLD F. RICHARDS, Ph. D.

(*Continued from page* 233)

readily calculate the speed of the bullet as soon as the speed of the moving film has been determined. The ordinary methods of determining the speed of rotation of the motor which moves the film are entirely too inaccurate to be relied upon for a measure of the excessively short interval of time required for the bullet to travel two or three feet, and accordingly an intermittent beam of light is used to place a time calibration upon the film just below the record made by the steady beam which is to be interrupted by the bullet. The second beam of light is rendered intermittent by means of a narrow slit and a very small vibrating mirror. The slit is so mounted that light can pass through it only when the vibrating mirror occupies one particular position. This position is ordinarily chosen to be that in which the mirror is moving at its maximum speed, so as to render the resulting lines on the film as narrow and sharp as possible. Thus a succession of fine lines are produced on the moving film, two for each complete vibration of the mirror, and the interval of time corresponding to the distance between two of these lines is known as a result of using a standard tuning fork to vibrate the mirror. A tuning fork is especially well suited to furnish this time-calibration, because its frequency depends only on its rigidity and distribution of weight, and not at all on its amplitude, that is, the width of the excursions of the vibrating prongs, so that its rate of vibration remains very constant. It may be operated by striking it with a light hammer just before the bullet is fired. If the frequency of the fork is 1,000, 2,000 lines will be ruled on the moving film per second; and if the speed of the film is 67 feet per second, 0.4 inch on the film will correspond to a time-interval of 1/2000 second. This distance can readily be measured to the thousandth part, so in effect we h here a clock registering one millionth second. If after firing the bullet we a distance of 1.4 inches between the tracks of the bullet, we then know tha bullet required 0.00175 second to travel between the two foci of light; and if these were three feet apart, we immediately calculate the speed of the bullet to have been 1,714 feet per second, or approximately 20 miles per minute. This result is such as might be obtained with a 0.22 calibre target automatic pistol.

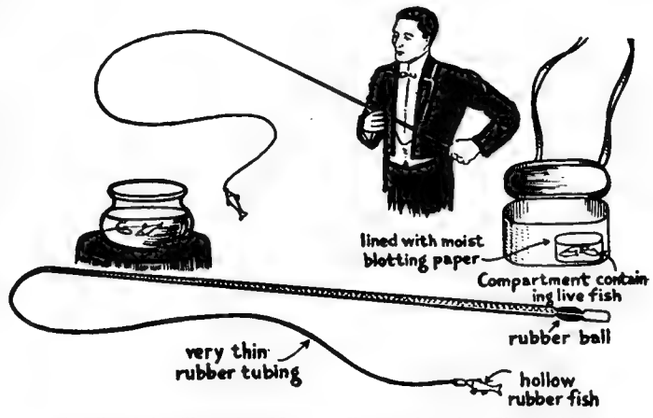
One very great advantage of this device is that the flight of the bullet is not in any way interfered with during a measurement, so that by using several similar devices at once, ballisticians can determine the speed of the same bullet at as many different points of its path as may be desired. By such measurements not only can the effect of air-resistance upon projectiles of different shapes and sizes be found with great ac-

Magic For Every

By PROF. JOSEPH DUNI

(*Continued from page* 245)

filled to the brim with water. The magician explains that fishing in water and making a successful catch depends largely upon the luck of the angler, and his ability as a fisherman. But fishing in mid-air is quite another thing. This, as he explains, depends upon the ability of the magician to see the invisible fish floating about in the atmosphere, as well as the faculty of being able to catch them at the end of his hook. In this case as in all others the conjurer explains a bit of bait is necessary and he at once proceeds to bait the end of his line by removing the necessary worm from out his basket and to all action and appearances attaches it to his hook. The line now dangles about in space for a number of seconds and behold! much to the amazement of the spectators, a small form of brig[illegible]ellow is seen dangling from off the en the line. The conjurer draws in the and removes therefrom a small gold fish.



Details of the Champion Mystery Trick—Catching Fish in Mid-Air.

Again the performer rebaits his line, another moment or two of angling in mid-air and another fish appears on the line.

The fishing line consists of very thin rubber tubing which leads clearly through the fishing rod down to the handle, where it is affixed to a rubber bulb. The fish that appears on the end of the line is an imitation, being nothing more than a small rubber bag shaped and colored to represent a fish. The bait which is permanently affixed to the line is a small piece of metal tubing. It will be seen that when the air in the apparatus is released the rubber fish is con-

(*Continued on page* 307)

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"BUILD YOUR OWN" WITH "RASCO" PARTS!

THE Radio Specialty Company—"RASCO" for short—now in its third year, is unquestionably the most unique radio parts supply house in the United States, if not in the whole world. This Company makes a specialty of very small orders. No order is too small to get immediate and prompt attention. The reason is simple: 80% of our orders are small.

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RADIO FREQUENCY TRANSFORMERS

The best Radio Frequency Transformer developed so far. Designed for us by Mr. R. E. Lacault, Associate Editor of RADIO NEWS. For wavelengths of 320 to 420 meters. Air core. Guaranteed to do the work. This Transformer brings in the long distances.

R-2800 Radio Frequency Transformer, size 1⅞"x2½" $2.00

VACUUM TUBE SOCKET

Made entirely of composition. Gives no rise to capacity effects, as metal sockets do. Positive contacts.

R-6500, Vacuum Tube Socket .....$.35

ANTENNA CONNECTOR

Made entirely of aluminum. Will not rust. The four wires go to upper holes. Lower hole takes lead-in. Don't solder your aerial. Dimensions, 2" high, 1¾" wide.

R-999, Antenna Connector $.30

MOULDED DIALS

Highest grade made. Brilliant black composition. Figures inlaid in white enamel. For ¼" or 3/16" shaft.

R-3074, Dial, 2½" .....$.55
R-3075, Dial, 3½" ..... .65
R-3076, Dial 3⅞" ..... .80

FLUTED KNOBS

Made of best black composition, provided with 8/32" bushing. Height 1", Diameter 1¼".

R-2055 Fluted Knob.....$.15

"RASCO" POSTS

R-650, Post made entirely of best black composition—8/32" screw—each .....$.08

R-202, Post has nickel-plated bottom part, each..... .08
Dozen, each style ..... .90

RASCO SWITCH POINTS

Nickel-plated and polished. The following have been found the most popular.

1, ⅛"x1¼", 6/32" thread, doz.....$.35
2, 3/16" high, ¼" dia., 6/32" thread, doz. ..... .35
3, 3/16"x3/16", 4-36 thread, doz... .35
4, ¼" dia., ⅛" thick; shank 6/32" doz. ..... .40
5, ¼" dia., 3/16" thick; shank 4-36, doz. .40
6, 3/16" dia., 3/16" thick; shank 4-36, doz. .40
7, 3/16" dia., ⅛" thick; shank 4-36, doz. .40
75, Switch Stop ⅛" long, 4-36 thread, complete with nut, each ..... .04
76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼" dia., 1/16" thick, doz. ..... .40
77, same as above, but head is ¼" dia. x 3/16" thick, doz. ..... .40

SOCKETTES

Substitute for Vacuum Tube Socket. Four of these take one Vacuum Tube. Grasp tube firmly. Best contact possible. Take less room. Are better.

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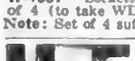
R-1551 Sockettes, nickeled, set of 4 (to take WD-11 Tube) ..... .25

Note: Set of 4 sufficient to hold 1 Tube.

VACUUM TUBE FUSES



Insure your tubes against blow outs.

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R-2576, Fuse, 1½ ampere ..... .15
R-2577, Fuse, 2 ampere ..... .15

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THE bearing to hold variometer and variocoupler rotors. Total length of bearing 2¼". Outside shaft, 1¼". Length of thread 1". Length of threaded sleeve, ¾".

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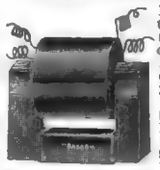

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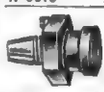
R-5002	50	240- 720	.50
R-5003	75	390- 910	.55
R-5004	100	500- 1450	.60
R-5005	150	600- 2000	.65
R-5006	200	900- 2500	.75
R-5007	250	1200- 3500	.80
R-5008	300	1500- 4500	.85
R-5009	400	2000- 5000	1.00
R-5010	500	2800- 6100	1.15
R-5011	600	4000-10000	1.30
R-5012	750	5000-12000	1.45
R-5013	1000	7900-15000	1.70
R-5014	1250	9750-19500	1.95
R-5015	1500	14500-26500	2.20

CORD TIP JACKS



Take the place of binding posts on instruments or panel. Cord tip firmly gripped by jack. Made of brass, highly nickel-plated and polished. Screw to attach lead wire. No soldering necessary.

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R-6603, 3¾" I.D., 4" O.D. x 5" L..... .27
R-6604, 4" I.D., 4¼" O.D. x 5" L..... .35
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R-251, Micanite Tubing, 6" dia., 6" long 1.60

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This wire is square, measuring 1/16" by 1/16". Easy to solder as it is already tinned. Used on all up-to-date instruments. Sold in 2-foot lengths only.

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R-6032, Brass Rod, 6/32" thread, per length ..... .06
R-1425, Brass Rod, plain ¼" round, per length ..... .10
R-3616 Brass Rod, plain 3/16" round, per length ..... .06

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Base is solid black composition; mounted on same is nickel holder and binding post, which holds the fluted hard rubber knob with its sliding rod member. Patent nickel detector cup and binding post. Patent cup holds crystal.

R-1898, Baby Detector, with Galena .....$.50

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Our patent spring fork holds the switch handle always at a uniform tension. At the same time it insures best contact possible. New wiping contact covers every portion of the switch point. Double leaf blades used.

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The circular plate is our new Binding Post Name Plate. Diameter, ⅞". These denominations: PHONES, GROUND, —, OUTPUT, "A" BATTERY —, "B" BATTERY —, LOUD SPEAKER, GRID, LOAD, "C" BATTERY —, AERIAL, +, INPUT, "A" BATTERY +, "B" BATTERY +, LOOP, TICKLER, PLATE, "C" BATTERY +, FILAMENT.

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R-834 to 868, Square Name Plates, each..$.04
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R-840 "INCREASE CURRENT" (Left)
Each ..... .10

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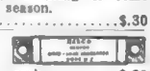
Cleverest vernier made. Can be used with any dial. Soft rubber ring engages dial. Does away with vernier condenser. We guarantee results. All metal parts moulded in best black composition. Nothing to come apart. Biggest hit of the season.

R-1450, Vernier .....$.30

"RASCO" CONDENSERS



R-5050, Phone Condensers, each.....$.20
R-5056, Grid Condensers, each..... .20
R-5059, Grid Leak Condensers, each ..... .30

COPPER FOIL

Thinnest copper foil made, .001" thick. Comes 4" wide.

R-5025, Coper Foil, per ft. $.10
10-ft. length ..... .80

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Weather resisting. Used particularly for cementing covered wires. Coils covered with this cement require no form. Wires hold together solely with this cement.

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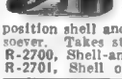

For the experimenter we list this composition shell and cap. No holes in shell whatsoever. Takes standard 2¼" diaphragm.

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R-2701, Shell only ..... .40

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These windings, with the switch arm shown below, constitute a complete rheostat for the experimenter. Resistance wound on flexible black fibre. Carries 1½ amperes, resistance 6 ohms.

R-4300, Rheostat Resistance each .....$.20
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Fits above.

R-1675, each .....$.10

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We list only best qualities. "DCC" means Double Cotton Covered. "GS" means Green Silk. "E" stands for Enameled. The following come on 8-ounce spools:

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R-2503, DCC No. 24..... .85
R-2504, DCC No. 26..... .95
R-2505, DCC No. 28..... 1.15
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R-2511, GS No. 30..... 1.05
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The following come on 8-ounce spools:

R-2514, E No. 20.....$ .45
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R-2517, E No. 26..... .65
R-2518, E No. 30..... .70
R-2519, E No. 32..... .80
R-2520, E No. 36..... 1.00

LITZ WIRE

R-323, equals No. 25 B&S, per foot .....$.02
R-890, equals No. 28 B&S, per foot ..... .01
R-891, equals No. 21 B&S, per foot ..... .03
R-892, equals No. 20 B&S per foot ..... .04
R-893, equals No. 14 B&S, per foot ..... .12

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Repairing Player Pianos

By FRANCIS G. Le MERLE

(*Continued from page 247*)

All actions similar to the standard pneumatic action should require approximately the same amounts of cloth to cover them. A lengthy explanation on how to take down or disassemble numerous makes of piano actions would be out of place in this article, but it can be said that the standard pneumatic action is one of the simplest, and similar actions would present no difficulties.

In disassembling, all one has to do is to use his head a little, there being no cause for uneasiness when this operation is undertaken; a close inspection will generally reveal how the different parts are put together. It is well before disconnecting any part to mark both it and the part it is joined to with the same numbers or letters so that no difficulty will be experienced in reassembling.

The exhausters, 1, equalizers, 2, governor, 3, and expression pneumatics, X, are in the bottom part of the piano. These are clearly shown in photograph A. Take these out carefully and lay aside, next take the upper action out, which consists of the motor, tracker, and stack of hammer pneumatics. There are generally three shelves, 6, shown in photograph B, to which the hammer pneumatics are fastened one above the other. Now disassemble the upper action by separating the primary valve section from the secondary valve section. This is done by removing four or five screws on top of the action, and the screws in the front "L" board, 10, where it joins the secondary pouch board, 9, as shown in photograph, C. The screws, which fasten the shelves containing the hammer pneumatics to the secondary valve board, can now be removed, and after having unscrewed one of the leather nuts, 8, shown in photograph, B, on each wire that connects each little bellows with one of the 88 striking fingers, the shelves come apart and can be laid aside. Also disassemble the bellows in the bottom part of the action, consisting of the exhausters, 1, equalizers, 2, expression pneumatics, X, governor, 3, etc.

Remove the motor, 4, and take off every alternate motor bellows and also every alternate bellows from the shelves of hammer pneumatics, shown as 6 in photograph, B; this is necessary to facilitate the removal of the old cloth and make same accessible, and enable one to get into same, as the bellows on the motor and shelves of hammer pneumatics are very close together. It is thus only necessary to remove every alternate one, as there will then be plenty of room to work around those remaining on the motor base and shelves.

The removal of the bellows is accomplished by driving a table knife carefully between the bellows and the part it is glued to; if this is carefully done very few of the bellows will be split, but should some splinter up do not be alarmed as the pieces can be glued together and are as good as they were before breaking. A piece of wood well glued together after being broken is stronger than it was before the break occurred.

We are now ready for stripping. Tear the rubber cloth off where it has been glued to the bellows with a quick, even pull. If there are any pieces of card-board found glued to the inside of the cloth that comes off the exhausters and equalizers, remove same carefully, and glue on in the same position to the new cloth, when the hot gluing-on process is being carried out, as this card-board is used to hold the folds of these larger bellows in place when they collapse.

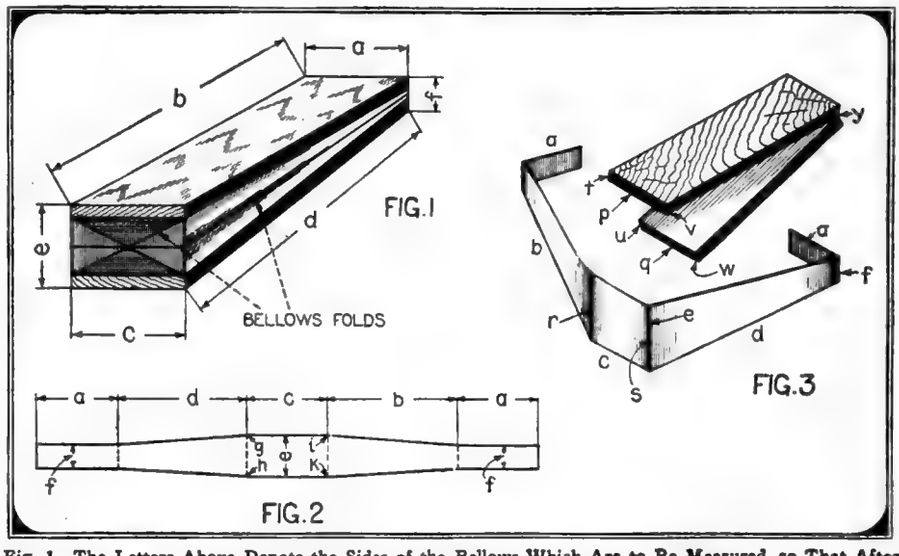

Fig. 1. The Letters Above Denote the Sides of the Bellows Which Are to Be Measured, so That After These Dimensions Are Taken They Can Be Used to Make a Pattern as Shown in Fig. 2. Fig. 2. How the Pattern by Which the Rubber Cloth is Cut Will Look. Fig. 3. The Cloth Covers Cut by the Aid of the Patterns as Shown in Fig. 2 Are Glued Around the Bellows, Fig. 1, as Shown Herewith. The Two Pencil Lines r, and s, Are to Line Up with the Points t, u, v, and w, on the Two Bellows Boards, p, and q, While y, is the Hinge of the Bellows.

Before stripping you should get the dimensions of each one of the different bellows or sets of bellows, so that you can make a galvanized iron or paper pattern for a new cover for same. This is done by opening out one of the old bellows as far as it will go and measuring the sides, a, b, c, and d, of the bellows as shown in Fig. 1, count a twice, as this is the hinge of the bellows and one part of the cover overlaps the other part at this point; e and f are the width of the front and rear of the cover, respectively. After the paper and galvanized-iron patterns have been made from these dimensions they will look like Fig. 2.

Now, as we only have to make from two to five covers alike for some of the bellows, the paper patterns will do for same, but where we have to make 88 covers for the hammer pneumatics it would be quite slow and tedious work, marking around a pattern 88 times, so we make a pattern out of the galvanized iron for these and we file

(*Continued on page 274*)

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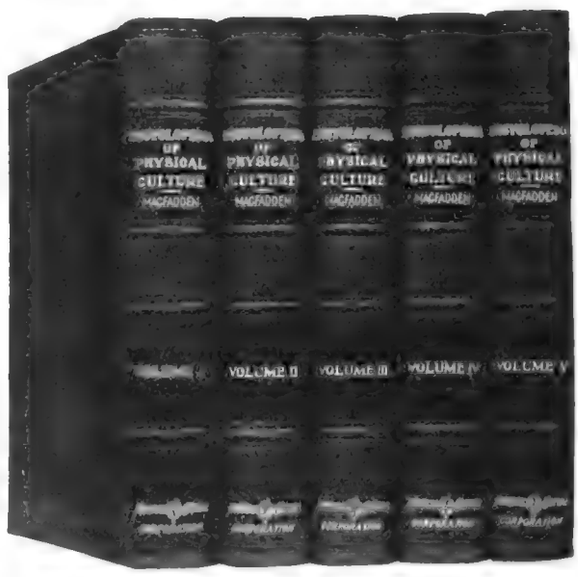

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apply all methods of drugless healing
give first aid in emergencies
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recognize diseases by manifestations
build nervous energy
treat the common forms of disease
understand the process of reproduction
benefit by laws of sex and marriage
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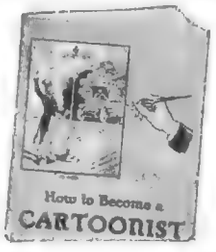

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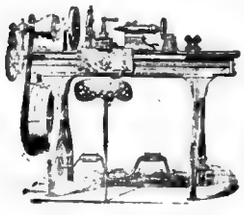

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Repairing Player Pianos

(*Continued from page 272*)

little V notches at the points, g, h, i and k, Fig. 2, with a three-cornered file to assist in marking the cloth when it is being cut out.

We now lay the pattern on the cloth to be cut, place the piece of metal rod on top and fasten to a table with the "C" clamp with a piece of thin card-board underneath so that when cutting around the pattern with the safety razor blade you will not cut into the top of the table, photograph D. Put a dot on the cloth with a pencil at the V notches, g, h, i and k, Fig. 2, so that, after the pattern is removed, a line can be drawn with a pencil from g to h, and from i to k, which will assist in gluing the cloth properly to the two boards of the bellows. Photograph D shows all this, also the tin can of glue with fitch brush in it, all floating in a saucepan of boiling water.

All of the patterns should be cut out and everything straightened up and put in order before commencing any gluing process. Make the glue by placing a sufficient quantity of the flake glue in the tin can with water to make about a pint of liquid glue having the consistency of syrup, heat this on the stove by floating the can of glue in another utensil or can of boiling water, keep glue good and hot and well stirred at all times when applying.

When ready to glue on the cloth give the parallel sides of the bellows, p and q, Fig. 3, a coating of glue, then place the cloth in position, using the pencil lines, r and s, which have been previously drawn on the cloth to line up with the points, t, u, v and w, on the boards of the bellows; then glue the cloth down each side and, last of all, glue the cloth on at the hinge, y, of the bellows, gluing one of the ends, a, over the other.

After all of the bellows have been covered consisting of those which were removed from the motor and shelves and those which were allowed to remain on same, the process of replacing those which were removed and gluing them in place will now have to be attended to. Do this carefully, using plenty of glue, and see that they are in the same position as originally; the bellows remaining on the shelves and motor base will assist in this. Set aside to dry overnight; reassemble all the parts carefully, and test for leaks. This is done by closing up the openings that lead to the bellows with a card, after first having shut up the bellows, if on trying to open the bellows up again there is considerable resistance the bellows is known to be tight, but should it open up easily there is a leak somewhere and same should be found and closed up with a dab of glue.

After the player-piano is completely reassembled it will be found to play like a new one, provided the parts have been put back properly and correctly adjusted. The manufacturers of the different makes of player-pianos will gladly send an instruction book on how to disassemble, regulate and reassemble their actions to anyone applying for the same.

The Yardstick and Thermometer of American Industries

By S. R. WINTERS.

(*Continued from page 240*)

by exhausting the air within to a pressure as low as one-third atmosphere. Aviation engineers are here testing the units of mechanism operating under conditions permitting of careful scientific measurements. Devices have been developed for measuring the rate of altitude of an airplane. Also investigations are being made to determine the most satisfactory fuels for aircraft engines. The behavior of an aircraft engine when operating under a wide variety of conditions encountered in actual flight up to altitudes of 25,000 feet has been written on cards and this information is available to interested parties. This series of cards contain the most complete data ever obtained on an aviation engine.

A controversy has arisen between buyers and sellers of blackstrap molasses relative to the quality of same—the Bureau of Standards is acting as referee. A device for determining the density of molasses has been developed—the value of the product being predicated upon its thickness. Molasses for manufacturing purposes is largely bought on the basis of total sugar content and its density, this standard having been determined by this Government bureau. The Polarimetry Section of the Bureau of Standards has been instrumental in the development of the rare-sugar industry, insofar as it applies to this country. Sweetening is thus obtained from uncommon sources, such as alligator pears, wood products, lobster shells and dahlias.

Until recently the United States imported a quantity of its clay products from foreign countries. Co-operating with a potters' association in East Liverpool, Ohio, the Bureau has made satisfactory tests whereby whiteware pottery can be made altogether from American clays under commercial conditions. Of 46 compositions, more than half proved to be satisfactory and the American housewife can use tableware made from domestic clay. Critical tests applied to thirty-five kinds of ware, including both home-produced and foreign products, indicate that American-made hotel china is superior to the choicest imported brands. The home-made product shows greater resistance to breakage and chipping as well as to sudden temperature changes. One of the interesting tests conducted by the Ceramics Section during the past year was that of subjecting glass tumblers to a hot fire as a means of determining their quality. This test afforded a means of formulating specifications for the manufacture of glass products.

Optical glass, formerly imported from France, Germany and England, is being manufactured on a commercial scale in this country—largely guided by the efforts of the Bureau of Standards. Optical glass for scientific and military purposes is now obtained from a domestic source, there having been delivered to the United States Navy Department, in 1922, 2,647 pounds of optical glass for the construction and repair of optical instruments employed in naval service. Glass pots have been improved in quality by heating them very slowly to 300 degrees Centigrade and then burning them to a temperature in the neighborhood of 1,425 degrees Centigrade, where they begin to soften

(*Continued on page 289*)

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Scientific Tools of Modern Detectives

By Feri Felix Weiss

(*Continued from page 230*)

THE DICTOGRAPH

Now Slavic peasants, while extremely shrewd and cunning in many ways, are also very superstitious. When the suspected murderer entered the room he saw what he thought was his former master, the victim of his greed, come to life. (The other actors in this drama; parents, professor and police were hidden behind a curtain.) The awe-struck peasant dropped on his knees before his young master and begged, in fact, screamed for mercy as he believed he was face to face with a ghost. His prayer for forgiveness amounted to a confession heard by all those witnesses, and also taken down in shorthand by an official stenographer in hiding. It was an easy matter to deliver the peasant over to the hangman on the strength of all this evidence.

Dictograph transmitters have been made so sensitive that they can pick up sounds even through thin partitions or closed doors. The distance over which the sounds can be carried along the wires is practically unlimited, although, of course, a nearby place is safest for the reasons that a long wire connection is subject to accidents, breaks may occur, the wire is apt to be discovered and so on. As many operators as are needed can work in one line from a single transmitter, or if necessary, two or more transmitters can be put in separate places, and one or more operators connected to each transmitter. A small switchboard in the box allows the quick changing of circuits.

There is a *sound regulator* on the cord of the operator's headset so that he can regulate the volume of sound by the pressure of a finger. The headsets are like those of the telephone operator at big telephone exchanges in hotel lobbies, railroad stations, and the like. The standard outfit has one transmitter, two receivers, one headband, rheostat for adjusting the volume of sound, switchboard, batteries and ammeter. Also fifty feet of black silk waterproof cord and one hundred feet of secret phone wire, complete in a fibre carrying case made to resemble a suit case. The switchboard enables the operator to switch from one battery to the other, if the persons under surveillance are moving about. The standard switchboard is also made to take an extra headset, so that two or more operators can listen at the same time. The fibre carrying case has extra space in the top for extra cord or tools and is equipped with a strong lock.

There is, too, a *pocket secret 'phone* on the market which is identically the same as the standard set but without switchboard. It gets its electricity from a small flashlight battery instead of large dry cells. This whole outfit is contained in a small flat case, which will fit into an overcoat pocket like a kodak.

The wires can be covered with any color coating to match the surroundings: rooms, wall paper, curtains, or wherever they have to be hidden. I have heard recently of a wireless dictograph which is the last word in this kind of invention.

The installation of the transmitter or *button* as it is called in detective parlance, is simple enough, being generally fastened with glass pins or thumb tacks to the wall, molding or furniture and sometimes hidden in a telephone base. But where to put it so that it will be hidden from sight in case of a careful search on the part of the suspect is not such a simple affair as it appears to

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What Invention Is

Brought down to its simplest terms, that is exactly what invention is—the combination of two ideas; a problem which must be solved and a fact of mechanics or science which solves the problem. That is the way *every* invention has been made. So, although you may never have thought of it in just this way, every time you solve some problem in your daily life—at home, traveling, or in business—you are an inventor; you use the principles of thought and action which govern the Science of Invention!

You can see, therefore, how easy it is for you to develop your natural instinct to "fix things." The same processes of thought that almost instinctively told you to fix a rattling window with a wedge can be so well developed that you can learn to invent other things almost as easily and quickly. You know, too, that every invention is made only by thinking *inventively*. And every inventor is agreed that the principles of Inventive Science are so simple, so easy to learn that any one, regardless of training or education, can develop himself to become a successful inventor!

How It Is Being Taught

But, although the fact has been universally recognized, that Invention is governed by a few simple, easily acquired, fundamental principles, no one ever thought of putting these principles in black and white so that everybody interested in invention could read them. In spite of the fact that Thomas A. Edison made his famous statement that invention should be *taught* as a science, thousands of people continued to work blindly, doggedly, haphazardly to perfect their ideas.

But now you *can learn how* to invent. Fifteen famous inventors have at last given to the world the laws and principles of Inventive Science. They have shown every ambitious man and woman *how to invent*. They are *teaching* Invention, exactly as other people are teaching law, medicine, bookkeeping. Instead of spending years groping blindly, instead of wasting your time in useless, heartbreaking drudgery, you learn how to complete your ideas quickly; you learn how to think so you are sure to succeed.

One Little Idea May Bring You a Fortune

With every new advance, with every new discovery that the world experiences more problems are coming up—and more inventions are needed to solve these problems. Now, as never before are new inventions wanted, and the world will pay a fortune to the man or woman who gives it just one of the inventions it needs now.

But all inventions need not be enormously big. Little ideas will bring you returns equally as great. Eberhard who invented the rubber on the end of a pencil, has been paid hundreds of thousands of dollars for his simple idea. The man who invented the metal tip for shoelaces, the man who conceived the idea of the "humped" hairpin, the man who developed the metal tape measure; all have achieved success and wealth as great or greater than the inventors of large machinery.

Ideas for Inventions Everywhere

Whatever your position in life, whatever kind of work you do, you are constantly meeting problems which must be solved. Even so small an idea as a new kind of kitchen knife for your wife may prove to be the making of your fortune. As an office worker you may invent some little method which will simplify work, or if you live on a farm, you can invent some idea to meet one of your every-day needs.

The work you do, the life you lead, the problems you meet, all present you with innumerable opportunities to invent things. All you need is the ability to think inventively—to train your mind to connect two ideas—just as you connected the idea of the rattling window and the wedge—and you can be assured of success.

Little inventions like these have brought fortunes to their inventors

Learn How to Invent at Home

Take advantage of the opportunity offered you now. Get the advice and the help of the fifteen famous inventors who tell you all the secrets of invention. Learn how to develop your ideas so they will make money for you.

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But you learn more than just how to invent in this fascinating course. Thousands of inventors have lost the profits of their invention simply because they didn't know how to patent and sell their ideas. This complete course shows you just how to apply for a patent, how to protect your rights when your patent is granted, and how to dispose of your invention so you will get the greatest returns possible.

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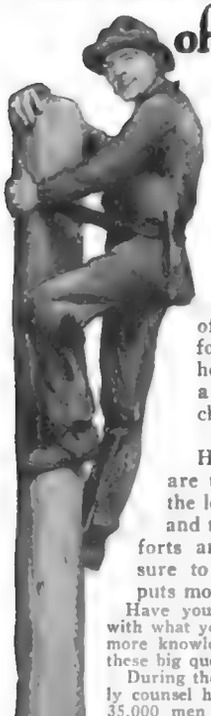
"I'm at the Top of the Pole



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A Metal in Paste Form

be at first glance, and the second difficulty is the matter of acoustics—the instrument must be so placed that it catches all the sounds from all parts of the room. A large room, of course, needs a number of transmitters placed in different corners, as a rule, over the molding near the ceiling. On the other hand, one transmitter may be enough for a small room, or where an interview is to take place between persons sitting close together; in which case the *button* is arranged so that the words coming from the subject's mouth shall strike it in a direct line.

I put one behind a picture of Lincoln when dictographing a certain conversation, and though the subject was talking straight into the picture and looking at it probably many times, he never realized that every word he spoke was taken up by the button behind Lincoln and sent to me over the wires, a distance of almost a city block.

A similar stunt was performed by the Secret Service in New York when they dictographed the conversations of the spies from a button hidden behind a life-sized portrait of the Kaiser in the German Club.

I dictographed, on another occasion, a big banquet of an alien society in one of the largest hotels in America. As the chief speaker was the object of my special attention, and as the waiters were all of this man's race, I had to use extra precautions when installing the transmitter so that they should not "get wise" to me. I crawled out of the window of an upstairs room to a balcony, then along a dangerous cornice, whence I dropped the *button* on its wire down to the level of the dining-room, where my assistant, unnoticed, pulled the button in at the open window, and hid it between the window-pane and the curtain. The scheme worked out well enough considering the difficulties we had to overcome.

The most successful job, perhaps, was one where we had to dictograph a *lady*, a clever, cunning spy. While our expert dictograph installer was putting the button behind a big upright piano, I was searching the lady's bedroom for letters, telephone addresses, visiting-cards and other incriminating souvenirs. When I entered the big room, the operator pointed with pride to the splendid hiding-place he had fixed for the button behind the piano. But his and my heart almost stopped when I called his attention to the tell-tale castor marks on the hardwood floor, caused by the pushing back and forth of the heavy piano during the installation of the button. As the lady was expected any minute and might surprise us in her room, we had to leave the marks where they were, sure that she—clever and astute crook that she was—would, of course, discover the dictograph behind the piano.

Just then a lucky idea struck me: there was a discarded doorbell up near the ceiling. To rip it off and replace it with our dictograph "button" hidden in a similar-looking call bell, the wooden cap of which hid the button and acted as a first-class sounding-board, was the work of a minute. We drilled quickly through the wall into the adjoining apartment and established connections with the listening headset. Things worked out as I expected. The *lady* discovered button number one behind the piano and fixed it so that she could take it off or put it on whenever she talked for our benefit. She felt perfectly safe, thinking that she had thwarted our schemes. She never thought—how could she?—of the "button" hidden in the bell near the ceiling in a dark corner which gave us the news we wanted. I slept in the adjoining apartment with the headpiece over my ears, and could hear when she arrived with her agents, friends or dupes, usually after a theatre or supper party. I could hear her open the door, talk to her little dog who would whine and bark, and then I would take her conversation almost word for word in shorthand over the "dick."

One of the hardest cases I have ever worked on with the aid of the dictograph was that concerning a very dangerous group of foreigners who were clever enough to hide their movements. It was highly important to get the hiding place of certain documents, or if not that, to get the contents of these documents which would brand the leaders as conspirators. I installed a dictograph at night behind a radiator in the room used exclusively for their conferences, ran the wire along the ceiling of an empty store, which was under the offices of this band, and wound up eventually in a little closet, away in the rear of this empty store. I camouflaged the windows of the store with big liberty loan posters to hide the interior from passers-by, especially at night where a light (necessary for stenographing) would have given our presence away. Then I sneaked in as soon as it was dark, closed the closet door behind me—not quite tight, in order not to suffocate—and turning on my electric flashlight, clamping on my headset, took down every word spoken in that conference-room, quite a distance above me.

I kept this up for about a week. Having thus obtained the information sought-for verbally, it was necessary to get a copy of the documents. I hid, therefore, during the next week in a stable across from the premises and watched the rooms of the conspirators nearly all night through powerful glasses to find out, if possible, where the documents were kept. I discovered that a safe was hidden in a camouflaged closet. Eventually we got into that room, opened the safe, made a photostat copy of the documents—and those conspirators don't know even to this day, how we got the goods on them.

The dictograph has proven of great value to chiefs of police and heads of detective bureaus in securing involuntary confessions from criminals by allowing them to talk with fellow prisoners. In this way, they will often divulge evidence that could be secured in no other way—not even by "third degree" methods.

District Attorneys often secure evidence of value and Claim Agents of railroads and other public service corporations trap fictitious claims for personal injury by installing the secret 'phone in private offices and waiting-rooms: hotel proprietors fit up several rooms with secret 'phone transmitters, and assign suspected persons to those rooms for observation: and Watch and Ward Societies and Vice Commissions have found it valuable for getting direct evidence of gambling, white slavery and other vices.

In detective agencies at least one dictograph outfit is absolutely necessary, and saves time and money in difficult cases. The use of this valuable aid has recently been seriously curtailed by the passing of a law in certain states, Massachusetts among them, forbidding the use of the dictograph or secret 'phone unless a special permit is first obtained from the Attorney General in each case.

THE TELEPHONE

That instrument of torture to the tired business man—as well as his time-saving angel—that which bridges mountains and oceans in a second and is at once a great help and grave danger to the detective, according to his management of it and the circumstances which govern him—*the telephone*—must not be forgotten in the enumeration of his aids.

The great trouble with this time-saver is that it is not secret. There are party lines where thirty-six or more subscribers listen-in every time the bell rings; there are telephones which leak: there are those which have been tapped or tampered with: telephone booths that are not sound-proof, where the detective in a neighboring booth has sometimes gotten a valuable clue or given away his whole case.

(*Continued on page* 281)

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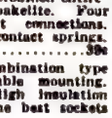

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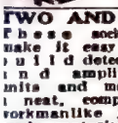
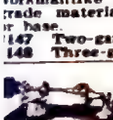


Our Special Socket. A wonderful value. Moulded entirely of brown bakelite. Four binding post connections. Right angled contact springs.
J140 Each 39c



High Grade combination type for panel or table mounting. Metal tube. High insulation base. One of the best sockets made.
J146 Each 45c

TWO AND THREE GANG SOCKETS

These sockets make it easy to build detector and amplifier units and make a neat, compact workmanlike job. Grade materials. Quickly mounted on panel or base.

Perfectly made of high

J147 Two-gang socket $1.05
J148 Three-gang socket 1.45

GALENA DETECTOR

Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish. An unequaled value.
J732 Each 59c

DETECTOR CRYSTALS CAREFULLY TESTED

J736 Galena, Arlington tested, per piece. 19c
J738 Silicon, Arlington tested, per piece. 19c
J735 Tested, Galena, per piece 9c
J737 Tested, Silicon, per piece 9c

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THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect.. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

"HONEYCOMB" COILS

Carefully made—fine looking coils. Highest efficiency. Low distributed capacity effect, low resistance—high self inductance. Very firm impregnation. Range given is in meters when varied with .001 variable condenser. Mounted coils have standard plug mountings.

Turns	Range	Art No.	Not Mntd.	Art No.	Price Mntd.
25	120- 250	J301	$0.39	J328	$0.89
35	175- 450	J302	.42	J322	.96
50	240- 720	J303	.48	J323	1.04
75	390- 910	J304	.54	J324	1.08
100	500- 1450	J305	.58	J325	1.19
150	800- 2000	J306	.63	J326	1.17
200	900- 2500	J307	.72	J327	1.26
250	1200- 3500	J308	.78	J328	1.35
300	1500- 4500	J309	.82	J329	1.36
400	2000- 5000	J310	.97	J330	1.57
500	2800- 6100	J311	1.12	J331	1.63
600	4000-10000	J312	1.27	J332	1.78
750	5000-12000	J313	1.43	J333	1.93
1000	7900-15000	J314	1.70	J334	2.28
1250	9750-19500	J315	1.92	J335	2.49
1500	14500-26500	J316	2.18	J336	2.65

COIL MOUNTINGS

J340 Three-coil mounting $3.95
J341 Two-coil mounting $2.95
High grade fine looking mountings. Polished black composition. Center receptacle stationary, two outer ones adjusted by knobs. Takes any standard mounted coil.

RADIO JACKS AND PLUGS

Finest grade jacks. Improved design. Best materials. Phosphor bronze springs. Silver contact points. Nickel finish. Mount on panels ⅛ to ⅜ in. thick.

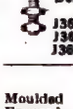
Jacks Only
- J390 Open circuit. Each.....43c
- J391 Closed circuit. Each.....49c
- J392 Two circuit. Each.....60c
- J393 Single circuit filament cont. 69c
- J394 Two circuit filament cont. 85c

J395 Plug. Large space with set screws for attaching cord. Each.....49c

BINDING POSTS

Brass, polished nickel finish. Washer and 6-32 in. screw extending ⅝ in.
J370 Large size—barrel and knob ¾ in. long, dozen..85c
J372 Smaller size—barrel and knob 9-16 in. long, dozen.....70c
J374 Large size with composition knob, dozen.....50c
J376 Large size with hole for phone tip or wire, dozen.....60c
J378 Small size with hole for phone tip or wire, dozen.....35c

SWITCH CONTACT POINTS

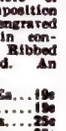


Brass polished nickel finish. All have ⅝ in. long size 6-32 screws and two nuts. All prices the same.
Dozen 18c Hundred $1.05
Order by Article Number.
J360 Head, ¼ in.; Diam. ⅛ in. High
J362 Head, 3-16 in.; Diam. ⅛ in. High
J363 Head, 3-16 in.; Diam. 1-16 in. High

SWITCH LEVERS

Moulded composition knob. Exposed metal parts polished nickel finish. Fitted with panel bushing, spring and two set nuts. A high grade switch.
J382 1½ in. Radius
J381 1¼ in. Radius
J380 1 in. Radius
} 19c Ea.

SWITCH LEVER STOP



Brass, polished nickel finish.
J385—Dozen 18c. Hundred $1.05

ONE-PIECE DIAL AND KNOB

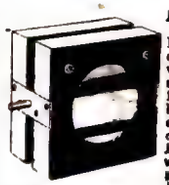
Moulded in one piece of polished black composition with clean plain engraved scale and numerals in contrasting white enamel. Ribbed knob to fit the hand. An attractive neat pattern.

J900 2 in. Diam. for 3-16 in. shaft. Ea...19c
J901 2 in. Diam. for ¼ in. shaft. Ea.....19c
J904 3 in. Diam. for 3-16 in. shaft. Ea....25c
J905 3 in. Diam for ¼ in. shaft. Ea....25c
J906 3½ in. Diam. for 3-16 in shaft. Ea...35c
J907 3½ in. Diam. for ¼ in. shaft. Ea...35c

OUTDOOR LIGHTNING ARRESTER

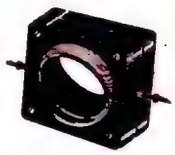
J980 Price $1.58
Protect your instruments with this lightning arrester. You cannot afford not to. Weatherproof porcelain case. Air gap type. Permanent. Durable. The most practical quality arrester obtainable. Underwriters approved.

VARIOMETER



J410—Completely assembled, price $2.69
Perfect in design and construction. Accurate wood forms of genuine solid mahogany. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency. A real bargain.
J411—Not assembled nor wound but all parts complete except wire, including winding form, $1.49

MOULDED VARIOMETER



Polished black moulded rotor and stator forms. Maximum inductance with greatest efficiency and minimum distributed capacity. A high grade durable instrument that will make up into a set you will be proud of and will get the best results. Wave length 180 to 600 meters. 4¼ in. square, 1⅞ in. thick.
J412 Price including mounting brackets $3.48

IMPROVED 180° VARIO-COUPLER

J418 Price $2.89
Our price shows you a big saving. An instrument of highest quality. The most efficient type of coupler, insures sharper tuning and louder signals. Primary and secondary wound on genuine bakelite tubes. Secondary connections through soldered flexible cables eliminates contact noises. Primary has 7 taps. Can be panel or table mounted. Range 180 to 650 meters.

MAGNET WIRE

Ingulated copper wire. Best quality even drawn wire, one piece to a spool. Prices quoted are for 8 oz. spools.

Double Cotton Covered		Enameled Insulation		Green Silk Covered	
Number J390		Number J392		Number J391	
Gauge	Price	Gauge	Price	Gauge	Price
18	50c	20	45c	20	$0.78
20	60c	22	55c	22	.80
22	75c	24	61c	24	1.05
24	85c	26	65c	26	1.18
26	95c	30	70c	30	1.70
28	$1.15	32	79c	32	2.05
30	1.65	36	98c	36	2.75

STRANDED ANTENNA WIRE

Cabled of fine copper strands. Very flexible. High tensile strength. Best for aerials.
J248—100 ft. coil 72c J249—500 ft. coil $3.20

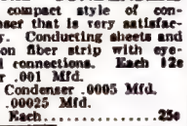
SOLID BARE COPPER WIRE

Solid bare copper wire for aerials, leads or wiring instruments.

Solid Bare Copper Wire, size 14
J240—100 ft. coil 49c J242—500 ft. coil $2.35

Solid Bare Copper Wire, size 12
J244—100 ft. coil 67c J245—500 ft. coil $3.05

ANTENNA INSULATORS



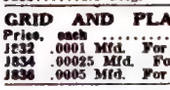
J260 Size 1x3¼
Two for 17c
J262 Size 2⅛x3¼.
Two for 55c
J264 Size 1½x4.
Two for 69c
J266 Size 1½x10½.
Two for $1.28

J260 J262 J264-6

PHONE AND GRID CONDENSERS

A compact style of condenser that is very satisfactory. Conducting sheets and dielectric are wound on fiber strip with eyelets for mounting and connections. Each 12c
J170 Phone Condenser .001 Mfd.
J172 Phone Bridging Condenser .0005 Mfd.
J174 Grid Condenser .00025 Mfd.
J175 Condenser .006. Each.....25c
J176 Grid Condenser .00025 with pencil mark leak. Each.....24c

TUBULAR GRID LEAKS AND CONDENSERS—MOUNTED STYLE



Very convenient. Permits quick change of leaks or condensers of varying capacities.
Grid Leaks Price Each 38c

Resistance		Resistance	
J850	.5 Meg.	J855	.2. Meg.
J851	.1 Meg.	J857	.3. Meg.
J853	1.5 Meg.	J859	.5. Meg.

GRID AND PLATE CONDENSERS

Price, each 55c
J832 .0001 Mfd. For special circuits.
J834 .00025 Mfd. For U.V.201 and Cun. 301
J836 .0005 Mfd. For U. V. 200 and Cun. 300

MOUNTINGS

Bakelite base. Spring clip contact.
J840 Single mounting. Each.....32c
J842 Double mounting. Each.....57c
J844 Triple mounting. Each.....77c

OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.
J234 10 to 1 Mounted. Each.....$3.48
J235 10 to 1 Unmounted. Each..... 2.89
J236 3 to 1 Mounted. Each..... 3.49
J237 3 to 1 Unmounted. Each..... 2.89

BARAWIK SPECIAL PANEL MOUNTING VARIABLE CONDENSERS

J812 43 plate .001 Mfd. $1.73
J813 21 plate .0005 Mfd. 1.43
J814 11 plate .00025 Mfd. 1.32
J815 3 plate Vernier ..... .98
These are especially high grade condensers and we guarantee them to be mechanically and electrically perfect. Fine polished and plates of heavy bakelite. Shafts ¼ inch diameter. Sturdy, heavy aluminum alloy plates perfectly spaced to insure smooth, even reliable capacity. Our low prices save you money. These condensers are of the very best make and are not to be compared with many inferior cheap condensers offered. We guarantee them to please you or your money back.

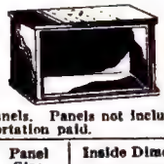
COMBINATION VERNIER VARIABLE CONDENSERS

J824 23 plate .0005 Mfd. with dial and knobs. Price....$2.89
J826 43 plate .001 Mfd. with dial and knobs. Price....$3.45
The latest improvement in condensers consists of regular variable condenser controlled by large knob and dial mounted with a three plate vernier condenser, which is controlled by separate knob mounted above knob on dial. This arrangement permits of very fine tuning. Compact convenient mounting on panel. High grade design and construction. Finely finished.

STANDARD BRAND HEADSETS

J754 Baldwin Type C with universal jack plug $11.75
J755 Baldwin Type C unit with cord $5.50
J758 Red-Head, 3000 ohm 5.78
J768 Brandes, 2000 ohm 6.90
J770—2000 ohm Barawick 3.75
J751 Murdock 56, 2000 ohm 4.20
J752 Murdock 56, 3000 ohm 4.85
J764 Frost, 2000 ohm 4.20
J766 Frost, 3000 ohm $4.85
J758 Western Electric, 2200 ohm..... 9.50

CABINETS



Fine looking cabinets solidly built. Elegant hand rubbed finish. You will be proud of your set mounted in one of these cabinets. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are transportation paid.

Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x 7"	5½"	6½"	7"	J420	$2.48
6x10½"	5½"	10	7"	J422	2.75
6x14"	5½"	13½"	7"	J424	3.30
7x14"	6½"	13½"	7"	J423	3.60
7x18"	6½"	17½"	7"	J426	3.90
7x21"	6½"	20½"	7"	J425	4.20
9x14"	8½"	13½"	10"	J428	3.70
12x14"	11½"	13½"	10"	J430	4.40
12x21"	11½"	20½"	10"	J432	5.25

RADIO "BAKELITE" PANELS

Notice our very low prices on this fine quality material. We supply genuine Bakelite, Condensite Celeron or Formica, all of which are materials with practically identical mechanical, chemical and electrical properties. Machines well without chipping. Won't warp. Waterproof. Highest mechanical and dielectric strength. Attractive natural polished black finish which can be sanded and oiled for extra fine work.

Panel Size Inches	⅛" thick Art No.	Price	3-16" thick Art No.	Price	¼" thick Art No.	Price
6x7	J450	$0.50	J460	$0.75	J470	$0.98
6x10½	J451	.75	J461	1.11	J470	1.47
6x14	J452	1.05	J462	1.55	J472	2.05
7x14	J455	1.28	J468	1.80	J478	2.40
7x18	J453	1.55	J483	2.30	J473	3.10
7x21	J457	1.78	J467	2.65	J477	3.60
9x14	J454	1.60	J464	2.30	J474	3.10
12x14	J455	2.10	J465	3.10	J475	4.15
12x21	J456	3.15	J466	4.65	J476	6.20

VARIABLE GRID LEAK

Pencil mark type. Resistance may be varied exactly as needed. J160 Each 19c

GRID CONDENSER

J162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF. 14c
J163 Same as 162 but higher grade. Enclosed in metal case. 39c

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KNOW WHO IS SENDING

Get twice the pleasure and usefulness out of your receiving set. Look up the name and location of any ship or land station whose messages you pick up—learn the name and address of that amateur whose sending set you just heard.

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Five of them are Continental Maps showing all stations throughout the world handling commercial traffic, with their calls; one showing the amateur radio districts of the United States and the principal radiophone broadcasting stations with their calls; and a map of the United States Weather Forecast Zones. Seven wonderful, two-color radio maps with a wealth of information that will give you a great deal of pleasure and knowledge.

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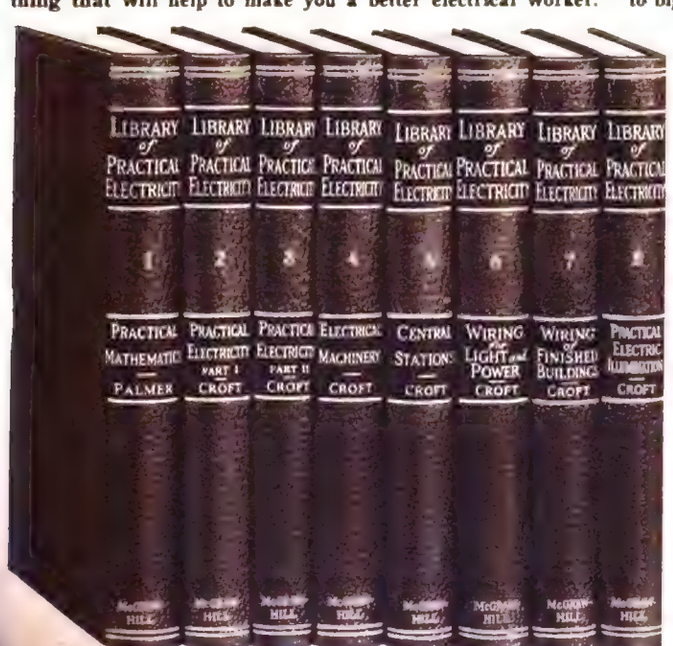

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$6.00 COMPLETE

No. 250

The "Rico" TUNED Melotone Speaker

THIS loud speaker is the outcome of several thousand experiments, and we present it to the American radio public in full confidence that we have produced the lowest priced and at the same time the highest class loud speaker on the market today.

The "RICO" TUNED MELOTONE SPEAKER is not a makeshift, not a toy, but a high grade scientific instrument, built in very large quantities in order to give the public the advantage of our low-manufacturing costs.

These are the specifications:

Adjustable and tuned "RICO" Loud Talker, fitted in cast metal base, handsomely finished, with two coats of baked enamel;
Nickel-plated and polished gooseneck;
Full fibre horn;
Five-foot attachment cord.

THE TUNED FEATURE

Our cross-section diagram shows our new adjustable feature, by which it is possible to make this loud talker give out almost any sound within reason. The MELOTONE SPEAKER can not possibly shatter nor rattle under any circumstances.

The new development comprises a specially-formed, pure Para Rubber Gasket, accurately made, upon which the diaphragm rests. By tightening or loosening the shell of the receiver its diaphragm approaches or recedes the desired distance toward or away from the pole pieces. So remarkable is this adjustment, and so wonderfully exact does it work, that any sound volume or quality can be readily obtained.

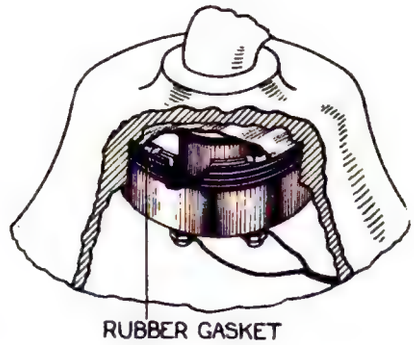
For instance, a given adjustment will bring in certain qualities of sound heretofore unobtainable. It is in your power to TUNE the MELOTONE SPEAKER in such a manner that if you wish a moderate amount of sound you can readily obtain it, or if you wish volume, as, for instance, band concerts, the adjustment can be made instantaneously.

By means of this new adjusting feature, the diaphragm can be moved to or from the pole pieces from .006" to .025". To make the adjustment, simply screw the case within the base of the speaker slightly backward or forward. **No screws, no nuts, no fussing, no damaged diaphragm.**

ACOUSTIC FEATURES

After you have listened to all of the expensive loud talkers, all we request is that you give ours a trial. You will find that it compares favorably with the most expensive loud speakers on the market.

The "RICO" MELOTONE SPEAKER gives quality and volume, without distortion, due to the tuned feature.



RUBBER GASKET

On two or three stages of amplification, any good radio outfit with the **"Rico" Melotone Speaker** will bring in the sounds loud and clear to fill a large room or hall. The fibre horn gives the mellow tone that is sought by every radio enthusiast. There is a richness of sound that compares most favorably with the most expensive horns on the market today.

In appearance, the "RICO" MELOTONE LOUD SPEAKER is a rich-looking and accurately, as well as scientifically-constructed instrument, that looks rich anywhere, among the best furnishings. Yet the size is not so large that the apparatus will appear cumbersome. Base is equipped with felt, to overcome resonance effects and to prevent the marring of table tops.

The dimensions are as follows: Length overall, 14½ inches; Length of horn, 11½ inches; Diameter of bell, 6⅝ inches; Total height of instrument, 9 inches; Diameter of base, 5 13/16 inches; Total net weight, 3 lbs.

Each MELOTONE SPEAKER is enclosed in a heavy corrugated box, and we guarantee safe delivery to you.

Order from your dealer or direct from us.

SPECIAL OFFER

We are so convinced that you will be enthusiastic about this loud speaker that we make this unusual offer:

Try the MELOTONE loud speaker for five days, and simply consider the money you are sending in to us a deposit. If, at the end of five days, you are not convinced that it is the best loud-talker you have ever seen or heard, return it to us and your money will be promptly refunded.

$6.00 SEND NO MONEY

USE COUPON BELOW

Note: The "RICO" TUNED MELOTONE Loud-Speaker No. 250 must be used in connection with a 1- or 2-stage amplifier or more.

Send for free illustrated literature of "Rico" Headphones; "Rico" Phonodapters; "Rico" tuned loud-speaker phones; fibre "Ricohorns."

SEND NO MONEY

COUPON S.L.-7

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(*Continued from page 276*)

Perhaps no detective has ever known better the advantages of the telephone and how to prevent himself and agents being traced through it than Paul Koenig, the cleverest, most ruthless, most systematic of hard-headed Prussians, who directed an army of his agents of German violence in America during the war. He had a dozen aliases, and gave our Secret Service, especially the bomb-squad of the New York Police, a run for their money. He was a past-master in the use of the telephone, although eventually it "got" him.

He had had wide experience as detective of the Hamburg-American line, a subsidiary of the German Imperial navy, and was under orders direct from Von Papen, the Embassy's military attaché as soon as war was declared in 1914. Suspecting that his own telephone wires were tapped and his conversations registered by detectives, he would instruct a new man to be at a public telephone booth the next day at 3.17 sharp. The man would be there. Exactly on the minute the telephone would ring, and instructions would be given by a strange voice, ending by telling the man to be at another telephone booth the next day to receive further orders. The person on the other end would be speaking at another pay station where no wire could be tapped.

A slip-up in a matter of time, however, "put" the government agents "wise" to his tricks. He telephoned one of his men to meet him at the Harlem Opera House in ten minutes. Now, as his own office was in the Hamburg-American Line building, near the South Ferry and it was a physical impossibility for anyone to get from there to Harlem in less than half-an-hour, it was clear to our government men listening in, that some other direction must be meant, and with this as a clue they were soon able to lay hands on him.

TELEGRAPHONE

I would like to mention briefly the advantages of a machine unknown to most of us, that is, the *telegraphone*. It might be useful to the progressive detective not only for the ease with which it takes commercial dictation, but still more for recording telephone conversations. It was invented by the Danish Edison, Valdemar Poulsen. It is a splendid "grafter trap," for the telephone conversation is recorded on a steel-wire by magnetic impulse, and repeated afterward just as if it had been spoken into a phonograph. It can be easily switched on to the regular telephone connection, and is locked in a box about twenty inches square. It will take anything from a crooked deal to a symphony concert, from the grunt of a pig to the song of a bird. It was used in the Rosenthal murder case by a prominent detective. It may eventually take the place of stenographers, for it was used at a medical convention not long ago, and accurate records of the debates were obtained for the first time in the convention's history, the technical terms and Latin phrases being difficult for the stenographer to get. A speech of former President Taft, made at the Wanamaker anniversary in the Philadelphia store, and recorded by this machine is still in working order though repeated thousands of times. This telegraphone "will put the Ananias Club out of business" as our friend "Teddy" would have said.

TWO FAMILIAR AIDS TO THE DETECTIVE

The *telegraph* which preceded the telephone is only secret to a limited extent. The companies controlling it are as careful to guard your messages as the Post Office authorities your mail, and not even Secret Service men could get copies of telegrams during the war. A special request from the Attorney General or a court's order was required to break this seal of secrecy, and then only for the protection of the armed forces of the United States. But telegraph wires have been tapped a good deal by all

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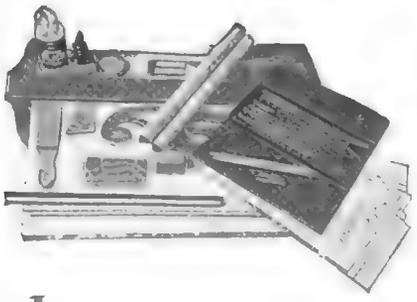

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sorts of crooks in the past: gamblers, bookmakers, stockbrokers, politicians, white-slavers, dope fiends and vermin of the underworld. As a rule they get caught, not so much because the wire tapping is discovered, as because their victims "squeal" and the authorities make wholesale raids on gambling dens, bucket shops, "the ponies" and similar "charitable institutions" where the fraudulent telegraphic outfit is discovered.

One of the most frequent games played on the gullible customers is the bucket shop which runs its wires to an upstairs room where a "pal" receives the order which the customer supposes has been sent to the stock exchange.

Great use can be made nowadays of the wireless by placing antennae on automobiles, trains and ships, and thus receiving important communications for the running down of rum smugglers, bandits, yeggmen, or the apprehension of murderers and other criminals. Recently the Chicago police—so it is reported—have been equipped with pocket wireless telephones through which they can get quick news of auto thieves and hold-up men, and by means of these some very clever captures have been made. It should be clear from these papers that the up-to-date, wide-awake detective will take advantage of all the latest discoveries described herein, as opportunity offers; just as the crook uses the electric light socket to give him current to burn out a safe door, or by employing an electric drill.

Some tools the detective can handle himself: the automobile, the motorboat, dictograph, telescope and camera; with others he will call upon experts and specialists to help him out. They cover a wide field; some giving quick results, and some the slow and tedious tests and chemical analyses of the laboratory; the photograph film, sensitive to the least ray of light; the reconstruction of a corpse from a few bare bones; the delicately scented lady's handkerchief, the volatile perfume of which may lead us to the criminal for whom we have been searching for many weeks.

But even when success is his, the modern detective will not sit down and bask in the sunshine of his achieved glory. He will always and everywhere look for new means of advancing his profession, seek here and there for new clues, new inventions, new discoveries which will aid him and others to capture and destroy the criminal element of society that law and order may be maintained and peace reign in our glorious land.

The End.

Around the Universe

By RAY CUMMINGS

(Continued from page 226)

The first man collected his scattered wits. "Well, what *did* you say?" he demanded.

"I didn't say nothin'," Tubby responded. Then to change the subject he added abruptly:

"Who was he—said all this?"

"A Perfessor—an—an Astronomer," replied the first man. "Us heard him give a lecture last week."

"Did he say the moon had people on it?" Tubby persisted.

The first man, confused by the sudden introduction of this new topic, answered sullenly:

"No, he didn't say nothing about no people in the moon."

"What you gettin' at, Tubby?" the third man put in. "We're talkin' about Space, not no men in the moon."

Tubby smiled genially. "*I'm* talkin' about the moon. I read a book by a guy named Wells. Now he says——"

"*He* ain't no Astronomer," the first man objected. "What's he know about it?"

The third man continued the attack.

"Stick to what you were sayin', Tubby. *You* said there would be somethin' at the edge of Space—not just more Space."

"I didn't say nothin' about it," Tubby repeated. "But I *will say* . . . . There *is* an edge to Space because when you get there you wouldn't find more Space, you'd find——"

"What?" demanded the first man aggressively when Tubby hesitated.

"Why—why more Land—that's what you'd find." Tubby glared through the blue haze of the tobacco smoke that hung like a pall about the unventilated room. "More Land," he repeated triumphantly. "Ain't that argument enough? Don't that show Space can't go on forever?"

The third man was gathering up the cards and chips. "Let's go ahead with the game," he suggested. "This here argument ain't got no sense. You shut up, Tubby—you ain't in this."

"Right," said Tubby, with the magnanimous air of a victor. He shifted his feet more comfortably on the second camp chair and leaned back contentedly. "You don't want *me* talkin'. I can shoot your argument full o' holes in no time."

The first man insisted on proceeding with his astronomical narration, while Tubby listened idly. It was then—as he sat there vaguely sorting out in his mind the miscellaneous statements regarding stars, planets and comets which his friend was making—that his great gift was revealed to him. The revelation came unobtrusively—so unobtrusively in fact, that at first Tubby did not grasp its real significance.

"I *wish* they'd quit that talkin' an' go on with the game," he murmured to himself with annoyance.

It seemed quite logical that at that instant Jake should decide he wanted to resume the poker game. At all events, in another moment the chips were clicking on the board table—science was forgotten for the more absorbing intricacies of poker.

Tubby, even then not realizing his marvelous gift, was left alone with his thoughts. Enormously large numbers whirled in his head—strange words—orbits, suns, planets, comets, stars . . . . Stars! He seized upon that, as one word at least, that was really familiar. It was a beautiful night out, he remembered; and as he gazed upward to the dim, smoky rafters of the room he was sorry he was not outdoors.

TUBBY DISCOVERS HIS "WISHING POWER"

"I *wish* I could see them stars now," he murmured.

And quite naturally, there were the stars, brilliant and glittering, spread out above him like millions of diamonds on a huge blue-velvet cloth. The moon hung over a clump of trees, above Bill Hawkins' apple orchard.

There are some very surprising things that occur so naturally they do not cause surprise. The revealment of Tubby's marvelous gift was one of them. He was not surprised to see the stars, only pleased.

"I *wish* I knew somethin' really true about them stars," he muttered thoughtfully. And then with sudden vehemence:

"I *wish* I knew all about them stars. I *wish* I knew all about Astronomy—I *wish* I could see it all for myself."

He felt fingers plucking at his sleeve, and turning, faced the dim figure of a man who was standing by his side.

"I came," said the man softly, "because you sent for me." He stepped forward a little, out of the shadow to a place where the moonlight fell on his face. Tubby

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thought he had never seen so sad a face before. It was long and very thin. It needed a shave, Tubby thought; and its eyes were unnaturally bright. A thin wisp of scraggly brown-white hair was above the face; and below, just above the collar of a soft white shirt, protruded a perfectly enormous Adam's apple.

Tubby's gaze swept the man's thin, but somehow muscular-looking figure—bareheaded, coatless, the white negligée shirt with loose, soft collar and a flowing black bow tie; and very baggy tweed trousers that flapped on bony legs.

"I'm here because you wanted me," the man repeated. His voice was deep and throaty, and inexpressively sad.

Tubby felt immediately sympathetic. "I'm sorry you're so sorry about somethin'," he said consolingly. "I didn't mean to send for you. I——"

The man smiled gently, pathetically. Tubby stared at his Adam's apple, fascinated, for it was bobbing up and down as though its owner were swallowing rapidly.

"Oh, I don't mind," the man said patiently. "*You* couldn't help it. You wished you knew all there was to know about Astronomy ——" He paused, his voice trailing away.

"Right," said Tubby encouragingly. He felt somehow tremendously sad, but determined not to show it. "That's what I wished. And so you——"

"So, of course, because you have the power to make all your wishes come true, I had to hurry here to tell you everything you—wanted to know."

His voice broke; and Tubby saw, even in the dim moonlight, that his eyes were filling with tears.

"I'll tell you *all* about Astronomy," the man went on in his dull monotone. "But you won't believe me."

His utterly hopeless depression was contagious. Tubby swallowed the lump in his throat. He put out his hand and touched the man's elbow—a round, bony knob underneath the thin sleeve of his shirt.

"Yes I will believe *you,*" he said kindly. "I wouldn't never think you was a liar."

The man brightened perceptibly.

"Let's get acquainted," Tubby added. "Then you can tell me why you're so sad."

PROFESSOR WELLS-VERNE INTRODUCES HIMSELF

"My name is Isaac Wells-Verne," said the man. "Sir Isaac Swift DeFoe Wells-Verne, but my friends call me Professor."

"Mine's Tubby—pleased to meet you, perfessor."

They shook hands.

"What are you perfessor of?" Tubby asked, after an awkward silence.

Sir Isaac's expression, which had cheered somewhat at the introduction, clouded over again.

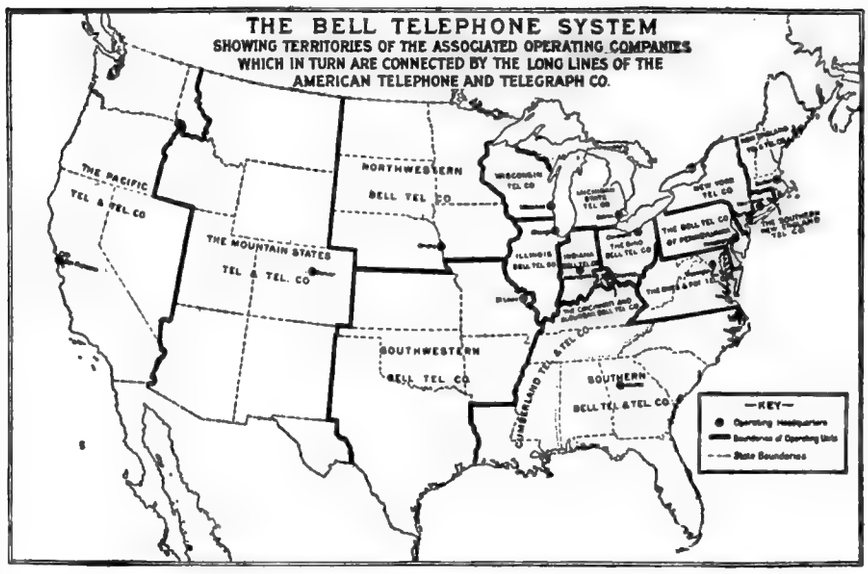
"Professor of Knowledge," he said sadly. "It is my business to know everything and to tell people about it—in writing."

"Oh," said Tubby.

"I do tell them—" Sir Isaac sighed heavily, and a tear slipped from one of his eyes and rolled down his lined face—lines of care, and of emaciation rather than age, for the man was not really old. "I *do* tell them—but nobody ever believes me. Life and people on the moon, for instance—" He sighed again: and shrugged resignedly. "I've told them all about that—and they don't take me seriously. They think because I've never been there, that I'm making it up. Sometimes they won't even buy what I've written. They—"

Tubby's fat little arm went around Sir Isaac's thin waist.

"Don't you care, perfessor. I'll believe you. *I* won't never think you're makin' nothin' up." A sudden thought occurred to him. "You're hungry, ain't you, perfessor? You *look* hungry. Did you eat today?"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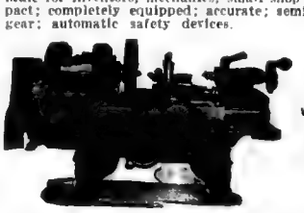

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"I—no, I didn't," Sir Isaac admitted reluctantly. "But I don't care about eating. I want people to appreciate my genius. I—"

"You *must* eat," declared Tubby. He expanded his stomach. "Look at *me*—I ain't never missed a meal in ten years."

The further thought struck him that possibly Sir Isaac had no money with which to buy food. McGuirk's lunch-wagon was less than a mile away—Tubby himself would pay for the meal. And then, as a climax to this mental activity, Tubby remembered his own newly discovered power.

"I wish we had a abso-*lute*-ly perfect dinner served right now, here on the ground," he declaimed abruptly.

And, even before Tubby himself realized his wish had come true, Sir Isaac was squatting cross-legged on the ground eating the food with avidity. Tubby had eaten only an hour before, and with difficulty he crammed down barely a third of the lavish meal. But Sir Isaac was equal to his task; and, for ten minutes, Tubby, completely satiated, sat in silence watching his new friend empty the huge silver platters. Tubby noticed now that from the pockets of Sir Isaac's shirt the stubs of three or four grubby lead pencils and a fountain pen protruded; and that the third finger of his right hand had a corn on it, near the end joint; and all his fingers were ink-stained. Also from each of his hip pockets, as he sat hunched forward on the ground, Tubby could see a huge bundle of folded manuscript, sticking out.

When everything edible was completely eaten, Sir Isaac sighed contentedly.

"I wish we each had a good cigar," said Tubby promptly: and striking a match deftly with his thumb nail, he courteously lighted the huge black perfecto which Sir Isaac had in his mouth.

With his own cigar lighted Tubby leaned back luxuriously and smiled at his companion.

"This ain't so bad," he declared cheerfully. "Now, perfessor, tell me all about *everything.* You can begin with—" He deliberated. "—begin with the edge of Space. These here guys—"

Tubby broke off, for a stupendous idea had just occurred to him. Sir Isaac knew all about everything—but he had not actually seen it. The Moon, for instance. He had never been there—that's why people wouldn't believe what he wrote about it. Now with his (Tubby's) ability to wish for anything, why not go there—go everywhere—and see *everything*? It ought to be possible . . . .

"Listen, perfessor," he said excitedly. "You don't need to tell me nothin'. Let's go see things for ourselves." He explained his idea vehemently.

Sir Isaac looked almost dazed for an instant. "If I only could," he said musingly, his deep voice filled with awe. "I know just what we would find—on the Moon, Venus, Mercury, Mars—everywhere, everything—I know it all. If only I *could* verify it—could see it all for myself—"

Tubby was standing up impatiently. "Come on, perfessor. Let's go."

Sir Isaac climbed to his feet mechanically, a look of exaltation on his face.

"If only I could—" he murmured; but Tubby interrupted him sharply.

"Come on. Don't be no goop."

"But where? How?" asked Sir Isaac almost stupidly, for the anticipatory joy in his heart had dulled momentarily even his gigantic intellect.

"I *wish* we could go anywhere in the Universe. I *wish* we were all ready to go now. I wish we had a—a abso-*lute*-ly perfect automobile an' house to go in," Tubby intoned rapidly.

THE INTERPLANETARY SPACE FLIER APPEARS

They both saw it the same instant, shining in the moonlight in a field not fifty feet away—a pale, grey-white, square metallic object, as large as the little building that housed O'Conner's Grocery.

"There it is," said Tubby. "What is it? Come on—let's go see."

Sir Isaac's eyes shone as he looked at it.

"My Inter-planetary vehicle," he murmured, pride and awe mingling in his tone. Without another word he gripped Tubby by the hand, jerking him forward at a run.

Tubby's breath was almost gone when they arrived. He stood leaning against the side of the vehicle, panting. The thing was indeed as big as a very small cottage. It was made of a metallic substance—similar to aluminum only different, Sir Isaac said. In shape it was like a huge cube with a little dome set on top. It had several tiny windows of heavy plate glass set in each side, with a small metal door in front, which door now stood invitingly open.

Tubby, his breath recovered, walked around the vehicle, inspecting it curiously; while Sir Isaac stood regarding it as a proud mother might regard her precocious offspring.

After a complete circuit outside, Tubby peered through the doorway into a dim interior.

"Come on in, perfessor. It's all ready, waitin' for us."

They went inside together; and Sir Isaac, as though he had lived in the place all his life, immediately switched on a light.

Inside, the vehicle was divided into several tiny rooms on two floors—just like a toy cottage, Tubby thought—and seemed fully furnished and equipped ready for occupancy. There was a store-room of food—a little kitchen, like the kitchen of a Pullman dining car—a main room, filled with a mass of scientific instruments—and two very small bed rooms upstairs. Tubby sat down on one of the beds tentatively. Its mattress was soft; its springs yielding but strong, and its coverings luxurious.

Tubby sighed with relief. "I ain't no kicker, perfessor, but I do like to sleep comfortable."

They went back into the instrument room, where Sir Isaac quietly inspected a little keyboard like that of a typewriter.

"What's that?" Tubby asked. "Do you know how to run this thing, perfessor?"

Sir Isaac straightened. His manner had completely changed. He was now forceful, commanding, dominant. Tubby was impressed by his look, even before he spoke.

"This is *my* Inter-planetary vehicle," he said sternly. "*I* invented it—*I* designed it—I have operated it, in my mind, many times. It is one of the most important of my contributions to science. I know *all* about it, of course."

"Oh," said Tubby. "That's fine. Then we're all ready to start, ain't we?"

Sir Isaac bowed gravely.

Tubby at the moment was standing beside one of the little windows. The moon was still over Bill Hawkins' apple orchard; and at the sight two ideas came to Tubby simultaneously.

"Just a minute, perfessor." Sir Isaac was about to close the heavy front door. "I ain't goin' 'til I wish all them apples of Bill Hawkins' is lyin' rotten on the ground. He's a mean guy, he is—wouldn't let me pick none *ever.*"

Tubby's eyes were sparkling with vindictive joy at the thought of this simple and efficacious revenge. "Come on, perfessor. Let's go see how all them apples look when they're rotten."

Sir Isaac's scornful.

"That is said shortly; and banged th

Tubby, vishing fervently and audi ophe would be-fall the ns, stood by the window ent to the key-board essed one of its keys.

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There was a faint but perceptible trembling of the room. Tubby's feet pressed hard against the floor and his stomach seemed falling. It was like an elevator that suddenly takes you up much too fast.

THE PROFESSOR AND TUBBY LEAVE THE EARTH

Sir Isaac switched off the light, plunging the room in darkness. Through the window Tubby saw a moonlit landscape silently dropping away beneath them.

He turned from the window after an instant, slightly sick and very frightened; but at once he felt better. The jarring had ceased. The room, in fact, was apparently motionless and quite silent. Tubby felt no further desire to look out of the window; he sat down in a chair, mopping the perspiration from his forehead with his shirt-sleeve.

Sir Isaac, his tall thin figure barely visible in the moonlit room, was still standing rigid by the keyboard, his fingers pressed delicately but firmly on its keys as a surgeon's assistant holds the patient's pulse during an operation. Tubby stared at him a moment, then ventured:

"Where—where we goin', perfessor?"

Sir Isaac moved, and as his fingers left the keyboard to itself Tubby's heart leaped. Would the thing fall if you didn't watch it? Evidently not, for Sir Isaac went over to the window quite calmly.

"We will not bother with the moon just now," he said thoughtfully, more to himself than to Tubby. "No, we can stop there coming home. . . . I think we should go toward the sun first, and then, after Venus and Mercury, skip back to Mars and so on out. . . . Yes, that will be best."

He turned away from the window toward Tubby.

"Our first stop will be Venus," he added authoritatively.

"Venus!" exclaimed Tubby. "That's fine. Then—then where do we go?"

"After that," said Sir Isaac slowly and impressively—"After that we will inspect the entire Universe!"

CHAPTER II

TUBBY AND SIR ISAAC PASS THE MOON, AND ARE FAIRLY ON THEIR WAY TO VENUS

"Come over here, Tubby," said Sir Isaac a few moments later. He had gone back to the keyboard, pressed another of its keys after making a rapid mathematical calculation with one of his pencil stubs on a little paper tablet, and now was standing quietly by the window again. "Come here, Tubby, and look out."

Tubby shook his head emphatically. "You look out. I ain't interested."

He was considerably more frightened now than a few moments before, for a very disconcerting thing had happened. He had secretly been reassured, as they started, by the knowledge that in the event of any dire disaster, he could easily wish himself safely back at home. It had been getting extremely warm in the room, and he had wished it would be cooler. But, so far as he could tell, it was getting still warmer, rather than cooler. Alarmed, he had wished vehemently that they were back on Earth looking at Bill Hawkins' apples. But nothing had happened. Sir Isaac was then making his mathematical computations at the keyboard; finally he had pressed another key carefully, and quite in defiance of Tubby's frantic mental wishes, walked quietly to the window.

Tubby considered the situation, and now decided to consult his companion about it.

Sir Isaac laughed softly.

"That was merely your *Earthly* power," he said condescendingly. "I suppose I am glad you possessed it, since you were enabled to bring into material being this interplanetary vehicle of mine." He raised his hand deprecatingly. "Of course, *I* could

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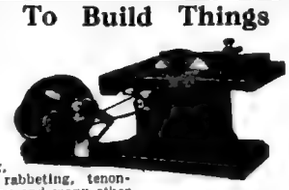

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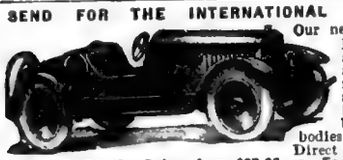

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easily have constructed it myself. In fact, I was intending to—as soon as I had the necessary money."

Tubby was aggrieved at this ingratitude. "An' then I—I ain't able to wish for nothin' no more?"

"No," said Sir Isaac. "Naturally not—since you have left the Earth. You are now in the realms of Science—subject only to rational scientific laws. That magical wishing ability you had was childish. *I* could never be concerned in an affair like that." He seemed to shudder at the thought, and added emphatically:

"*I* am a man of Science. Everything *I* have ever conceived has been strictly scientific. I am ashamed of you—and of course, now that you are in *my* realm, naturally all such foolishness has been left behind."

Tubby pondered this, sitting hunched up in his chair and sweltering in the heat. He was somewhat sullen; but presently, when Sir Isaac patted him kindly on the shoulder and assured him they were in no great danger, he cheered up a little.

"It's too hot in here, perfessor," he declared. "Can't we open the window an' get a little air in?"

Sir Isaac smiled at the idea. "There is no air outside," he said quietly. "We have already traversed the few hundred miles of atmospheric envelope and passed beyond even the most rarefied stratas of the Earth's atmosphere. We are now in space."

"Oh," said Tubby. "Well, just as you say. But it's awful hot."

Sir Isaac was bending down to squint upward through the window, which from where Tubby was sitting was merely a black rectangle.

"It will cool off presently," he said casually. "There's the thermometer by you. See what it says."

The room was now dimly lighted by one small electric bulb—which was lucky, Tubby thought, for there was not even moonlight coming in through the window. He found the thermometer. It stood a little over a hundred degrees.

An alarming idea came to Tubby; it would be terrible to smother and be so hot all at the same time. "Say, perfessor, how are we goin' to breathe when we use up all the air we got in here?"

PROFESSOR WELLS-VERNE EXPLAINS THE BREATHING APPARATUS

Sir Isaac reluctantly turned from his inspection of whatever it was showed through the window, and pointed to one of the instruments on a table over against the wall.

"In breathing," he explained, "we alter the air only in so far as we use up its oxygen and add to it an excess of carbonic acid gas. Now over there on that table is Reiset and Regnaut's apparatus—which *I* still consider the best of its kind. It produces oxygen from chlorate of potassium and releases it into the air as fast as we use it."

Sir Isaac smiled to himself with satisfaction. "I have thought of and provided for every contingency. The carbonic acid gas that we exhale, by reason of its greater weight, collects near the floor." He indicated several containers under the table. "Those hold caustic potash, which absorbs the carbonic acid gas. . . . I have explained all this in my books, but I suppose you have not read them."

"Yes—no," said Tubby. "Not all of them, I guess." He felt a little humiliated. "I ain't so very scientific, perfessor. You'll have to tell me things as we go along."

"I will," agreed Sir Isaac magnanimously. He pulled out his handkerchief and mopped his forehead. "It *is* hot. That's because of our friction in going through the Earth's atmosphere so fast. We're far beyond the atmosphere now—exposed to the intense cold of inter-planetary space. We'll be freezing in a little while—you need not worry about the heat."

Tubby glanced apprehensively toward his discarded coat, and tried to recall how many blankets there were on the bed upstairs.

Sir Isaac added:

"Come over here and look out the window. Don't be afraid."

Through the window Tubby saw the stars, brighter, more brilliant than they had ever been before. Freed now from the distortion of the Earth's atmosphere, they glittered like huge, sparkling diamonds, surrounded, not by the familiar blue of the sky as seen from the Earth, but by a profound inky darkness.

It was a marvelous—indeed a stupendous—sight. The whole extent of the heavens swarmed with stars and constellations of pristine purity. Here and there hung huge, spiral nebulous masses, fleecy white, and glittering with tiny blazing points of white fire. Some of the larger stars were blue-white, others silver, still others a dull glowing red; and across the firmament stretched that immense ring formed by an impalpable dust of stars, the "Milky Way," in the midst of which our own sun ranks only as a star of the fourth magnitude.

"Ain't all that pretty," Tubby marveled. His fear had entirely gone. "Where's the moon?"

"The moon is on the other side of us," answered Sir Isaac. "It is shining into the room next to this." The instrument room, in which they were, only extended half the width of the vehicle. "Looking out this window we cannot see the moonlight, for there is no atmosphere to diffuse its rays. . . . Stoop down and look upwards, Tubby."

Tubby squinted up through the window from beneath, and saw a very large, thin silver crescent—an enormous arch extending nearly a third of the way across the sky. It glowed with a blue, almost phosphorescent light, and its outlines were blurred and wavy. Some parts of it were brighter than others, and there were many dark, almost black spots.

THE EARTH SEEN FROM SPACE

"What's that?" he asked, amazed. "I ain't never seen nothin' like that in the sky before. Is that where we're goin' to? We must be almost there. What is it? Venus?"

"That's the Earth," said Sir Isaac calmly. "We have turned over, you see, because our base is heavier. We are falling diagonally away from the Earth, partly toward the moon and partly toward the sun. I shall head directly for the sun later tonight."

It was very hard for Tubby to realize that they were going the other way, having turned almost completely over; but finally he managed it. He was beginning to feel comparatively little surprise at anything any more.

"Why don't we see all of the Earth?" he demanded. "Why is it so thin—like a new moon?"

"Because the Earth is 'new'," Sir Isaac explained. "From the position we now occupy that is all that is illuminated by the sun's rays, though if you look closely you can distinguish the dim outline of the unilluminated portion of the sphere. You see the Earth is in its first phase. It——" He seemed contemplating the use of some profound scientific language; then, meeting Tubby's puzzled glance, he shrugged and gave it up.

"It *is* just like a new moon," he added. "Only it's a new Earth."

They inspected the moon itself a few moments later, through the window of the adjoining room. It hung apparently motionless just below the level of the window. All around it in the blackness, the stars shone as brightly as though it were not there—which, as Sir Isaac reminded, was merely because there was no intervening atmosphere to diffuse its rays and thus obscure the stars.

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The moon was somewhat larger than when seen from the Earth, and considerably brighter. Its rays bathed the store-room with a brilliant, blue-white light. Tubby was opening a box of crackers as he stood regarding it.

"Ain't that romantic," he murmured a moment later, with his mouth full of biscuit. "That's abso-*lute*-ly pretty moonlight. Come on, perfessor—eat somethin'. This travelin' so fast makes me hungry."

They made a very comfortable little midnight supper of sardines—which Tubby found in a well-filled ice box—and the crackers. Sir Isaac's appetite revived with eating, and he devoured such a prodigious quantity of the food that Tubby became alarmed over an ultimate shortage.

"It's quite all right, you know," Sir Isaac assured him. "We are supplied for over a year. I've never started on a journey like this—even a mental journey—without an entirely adequate food supply. Besides, we can replenish along the way. You will find the Mercurian cuisine particularly good."

It had been growing steadily colder; and Tubby, discovering that the tiny kitchen which adjoined the store-room held a very decent little gas stove, made them each a steaming hot cup of coffee.

"How cold is it liable to get, perfessor?" he asked, as they sat at an immaculately clean board table and drank the coffee. "Ain't this house got any heatin' apparatus? A nice little furnace now——"

"It can be heated," Sir Isaac answered. "But we shall not need it. It will be warm enough presently."

Certainly the weather in space was exceedingly changeable; but that was to be expected when one was traveling from place to place with such rapidity.

"But how cold would it get if we stayed where we are?" Tubby persisted. He was beginning to be theoretical also, which, as Sir Isaac had remarked, is the first prerequisite of a scientific mind.

"I think I once estimated the temperature of space to be about 250 degrees Fahrenheit below zero," remarked Sir Isaac. "Pass me the cream, will you? And the coffee pot? You make pretty good coffee."

"Thanks," said Tubby. "I ain't so terrible good at cookin'——" He paused deprecatingly, his amazement at Sir Isaac's estimation at how cold it could get forgotten in the compliment to his culinary skill.

"Minus two hundred and fifty degrees," Sir Isaac repeated thoughtfully. "I wish I could verify it now. But we won't suffer from the cold. Soon we shall be——"

As though in answer to his unspoken words, sunlight burst in through a window in the floor directly under Tubby's feet. He had not known this window was there, and leaped aside in terror. The vehicle at that moment had emerged from the conical shadow cast by the Earth, and the diagonal rays of the sun struck its lower surface. Bathed in its golden fire, which mingled with the moonlight from the side window, the room in a moment became warm and pleasant.

"This is nice," said Tubby, with rapidly recovered equanimity. He discarded his coat again, and pushed the hot coffee from him. "We sure do have speedy changes of weather, don't we perfessor?"

Sir Isaac had donned a pair of smoked spectacles and was on his knees peering down through the window. He called Tubby and offered him a second pair of the glasses.

Tubby sat down on the floor. The sun, through the smoked glass, appeared a glowing red ball, with enormous tongues of flame rising from it. The globe itself was no larger than usual. They were closer to it, Sir Isaac remarked, but its distance still was so comparatively great that its visual increase of diameter was undiscernable. Also, on Earth, the atmospheric refraction enlarged it.

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The sun was not directly beneath them, but off considerably to one side—on the side away from the moon. And, although Sir Isaac had already explained the phenomenon in the case of the moon, Tubby was greatly amazed to see the stars shining quite imperturbably all around the sun.

"That's the first time I ever seen stars shinin' in the daytime," he murmured.

Sir Isaac climbed to his feet. "I'll be back in a moment. I want to change our course and put on more speed."

He left Tubby sitting there and went into the instrument room, where, after a few more algebraic calculations and careful reference to a huge book that lay at hand, he depressed another of the keys slightly—and, after an instant's hesitation, two others on another rank of the keyboard.

Tubby, squatting on the floor in the other room, saw the sun and all the stars swing slowly over to one side—the whole firmament shifting silently under him. The sun was directly underneath when the movement ceased. Looking over to the side window he saw that the moon had risen considerably. It was now so high he could only see it because he was down on the floor.

Sir Isaac returned.

"We'll make good speed now," he said. "We're headed directly toward the sun, with eleven and a half times our former velocity." He sat down beside Tubby on the floor.

It was amazing to stare down through that window at the sun and stars—into the immensity of space directly under them—and to realize that they were falling into it. Yet Tubby was not alarmed, possibly because the vehicle felt so stable, so vibrationless, so absolutely silent and motionless. There had not been the slightest perceptible movement since that first instant when they started. In changing their course it was the stars and sun that appeared to move, not the vehicle.

Tubby pondered all this. "Why don't we feel like we was movin', perfessor?" he demanded some minutes later. "If we're goin' so fast——"

THE SPACE TRAVELERS BUMP INTO THE EINSTEIN THEORY

"My dear fellow," Sir Isaac answered, "you must realize that all motion is relative. There is no such thing as absolute motion—it all depends upon your immediate surroundings. Einstein might tell you that as something very new—yet *I* have always known it."

"I don't get you," said Tubby, puzzled.

"The Earth," said Sir Isaac, "is flying through space at the rate of some 66,000 miles an hour. You never felt that motion, did you? But when you are in a train going 60 miles an hour—that motion you *do* perceive. That is because, relative to your immediate surroundings, you are moving that fast. Do you understand now?"

"No—yes," said Tubby. "I guess so. Show me Venus. When do we get there?"

Venus, which fortunately was then approaching inferior conjunction—that point in its orbit when it is between the Earth and the sun—was discernable slightly to one side of the sun at a visual distance of about twice the sun's diameter. Tubby saw it as a very large, bright, blue-white star.

"A telescope would show it as a crescent in its last phase," said Sir Isaac.

Tubby, with their first stop in such plain view directly beneath them, was intensely interested. "Tell me all about Venus," he demanded. "An' tell me how you run this—this inter-planetary house we're in, so you can make it go where you want to."

Sir Isaac glanced at his watch. "Twelve fourteen. You must get some sleep soon. I will explain the operation of my vehicle tomorrow."

Tubby realized he *was* a little sleepy. "How long we been travelin'," he asked.

"Two hours and twenty-seven minutes." Sir Isaac pulled out a lead pencil and a little slip of paper and began a rapid calculation.

"We are now about 947,000 miles from the Earth," he announced.

"In two hours an' a half! That's some travelin'."

Sir Isaac smiled. "I should not say that—however, it is quite satisfactory. I started very cautiously. We went through the Earth's atmosphere considerably less than one one-hundredth that fast. I increased our velocity soon after that—and just now, when I altered our course, I increased it again eleven and a half times."

SOME FACTS ABOUT VENUS

"Go on," said Tubby. "Tell me more. Tell me about Venus."

"Venus," began Sir Isaac, "is a globe very little smaller and of very slightly less density than our Earth. Its mass, hence, is only a little less—gravity on its surface being .88 that of the gravity on the Earth. . . . Do you follow me? I'm only talking in round numbers, of course."

"Of course," Tubby agreed. "Go on."

'It revolves on its axis once in 23 hours, 4 minutes and 19¾ seconds. Those are my figures, you understand—they are quite exact. Therefore, its day is very similar in length to our own. Its orbit lies about 67 million miles from the sun—some parts of it further, some nearer. The Earth, you know, revolves at a mean distance of about 93 million miles from the sun. Venus makes one complete revolution around the sun in a little more than 224 days—hence its year is that long—about a third shorter than ours. Venus has seasons just as we have—only less marked. Its atmosphere is a little denser than ours, but altogether Venus is more like the Earth than any other of the planets."

"Good," said Tubby. "Go on."

"It has no satellite," Sir Isaac added as an afterthought.

"What's a satellite?"

"A satellite is a smaller body revolving about a planet, just as a planet revolves around the sun. The moon is the Earth's satellite. It revolves around the Earth about once a month."

"How far away?" Tubby demanded.

"Oh, very close. Only about a quarter of a million miles. We are already four times that far from the Earth. You can see how close the moon and Earth are together now. Look!"

Sir Isaac pointed to the side window, pulling Tubby over on the floor nearer to it. The moon had risen still further, and had dwindled greatly in size. The tip of the Earth, very much smaller than before and more silvery, showed in the upper corner of the window.

"Why, they're gettin' right together," Tubby exclaimed. "That moon really belongs to us, don't he? He's our little brother!"

"Yes," said Sir Isaac. "We'll stop off there going home. Now about our present velocity. Venus, at the time we started, was about 31 million miles from the Earth. We have already gone about one million, at an average rate of some four hundred thousand miles an hour. I have now increased this velocity to four million, six hundred thousand miles per hour."

Sir Isaac looked a little worried as he named these figures. "I hope we don't hit anything," he added anxiously.

"Hit anything!" Tubby echoed. He glanced down through the window at the heavens beneath. "Ain't we got plenty of room? It looks like we had plenty."

Sir Isaac sighed. "All space is relative to motion. We *haven't* very much room at this velocity. It's so crowded in here near the sun. Outside—particularly beyond Neptune—things will be different. Then I can really put on speed."

He shrugged. "You go to bed, Tubby.

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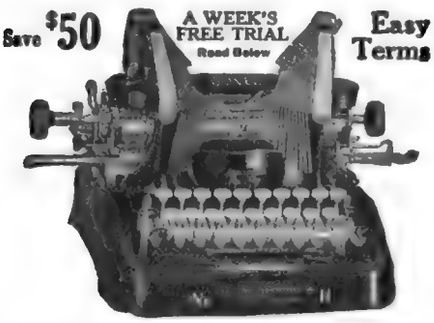

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I'll watch here. I don't fancy we're in any great danger."

"Right," said Tubby. "If you see anything comin' you steer around it." He got to his feet. "Good night, perfessor. I'm goin' upstairs right away. When do we land at Venus?"

Sir Isaac was again absorbed with his mathematics, the sunlight from below lighting with strange shadows his lanky figure and earnest, intellectual face.

"What?" he asked abstractedly.

Tubby meekly repeated his question.

"I shall alter our course later tonight," said Sir Isaac. "I am using the sun's attraction now. It's a little longer route, but simpler. Later I shall head directly for Venus and slow down somewhat."

He added:

"I'll call you about six o'clock. We will be fairly close in by then. We'll land shortly after breakfast. . . . Good night."

"Good night, perfessor. Don't make no mistake with them figures, will you?"

He turned, and climbing to the floor above, carefully selected the better of the two beds and soon was snoring heavily.

(*To be continued in next issue.*)

The Yardstick and Thermometer of American Industries

(*Continued from page 274*)

The rubber section of the Bureau engages in a variety of activities—ranging from the testing of shark leather as a material for the shoe manufacturer to that of determining the effect of age on jar-rings for fruit and vegetable cans. Also a study is being made of power losses in automobile tires, an endurance testing machine being in continuous operation for the purpose of wearing out tires until failure develops at some point. This information is of value to the approximately 12,000,000 automobile owners in the United States as well as to manufacturers of automobile tires. Shoulder straps and straps for tying the mail of the city carriers have been outlined for the Post Office Department. Shoe manufacturers and manufacturers of rubber heels were brought together as a means of adopting standards for rubber heels. The rubber section has recently installed machinery whereby it is possible to take whole sides of sole leather and convert them into shoe soles under circumspect laboratory investigation.

"What is the fatigue resistance of sheet metals?" is a question answered with precision by the Structural, Engineering, and Miscellaneous Materials Section of the Bureau of Standards. The metals thus tested were only 0.020 of an inch thick, being suitable for aircraft construction. For machines were designed for the purpose of testing these thin specimens, and although definite conclusions have not been arrived at, sheets of metals have been run for more than 10,000,000 alternations of stress without failure. The scientists are unwilling to draw conclusions until 100,000,000 runs have been made. The machine designed for making known the impact fatigue of thin sheet metals consists of a heavy cast-iron anvil, mounted on blocks of concrete. The specimens are clamped at their ends, and blows are delivered thereon by a tilting hammer, raised by a cam, and which falls freely from a determined height. The strength of motor-truck wheels, testing of oil-well material, testing of girder hooks used in building bridges, and the measuring of the hardness of metals, are among the variety of activities within the scope of this section of the Bureau of Standards.

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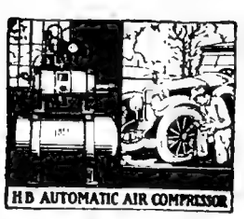

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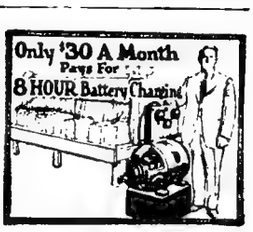

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Reflex Circuit Saves Tubes

By A. P. PECK

(*Continued from page 261*)

regulate the potential to the grid or grids of the tubes. This allows the tubes to work at their normal efficiency and reduces the so-called tube noises to a minimum. The potentiometers could, no doubt, be done away with by placing a biasing battery of the correct factors in the grid circuits of the tubes. The voltage of this battery would have to be determined by experiment and the battery itself could be made very easily from one or more flashlight cells connected in series. The voltage could be varied by means of a clip which could be changed from one to another of the terminals of the individual cells.

A word regarding the tubes suitable for use in these circuits would not be amiss at this point. The W.D.11 or its successor, the W.D.12, 1½ volt, dry cell tube could very well be used, and a plate potential of 45 volts should be applied. The potentiometer for use with this tube may be of any standard make and resistance. Since a crystal detector is to be used for rectification, no soft tubes will be necessary, as hard tubes are by far the better amplifiers. U. V. 201, V.T.1, and V.T.2 tubes will all give good results. The writer put together a set such as shown in Fig. 2, and with V.T.2's obtained great satisfaction. 120 volts on the plates gave the best signals, but the adjustment of the potentiometer was found to be quite critical; one point bringing in the signals with great volume and clarity, while at all other points, the music and voice was distorted and by no means as loud.

The writer has shown crystal detectors in all the circuits herewith, but if the user desires he may employ a detector tube for the purpose of rectification. The use of the crystal, however, simplifies the operation of the set to a great extent and eliminates the distortion which is liable to be encountered when a tube is used. An excellent detector for use in these circuits is the "Gold-Grain," as it is easy to adjust and keeps its adjustment very well. It has also the added advantage that it is entirely dust-proof. Of course, any ordinary crystal detector can be used with good results. Silicon and carborundum should stage at least a small comeback in this circuit as they are very stable under all conditions, and since great sensitiveness is not required, but rather capability of handling comparatively large currents, either of these crystals will give very satisfactory results.

The transformers used may be of any standard make, but if the builder wishes to make his own, he will find complete data on both radio frequency and audio frequency types in various recent issues of *Radio News* magazine. The design of radio frequency transformers was also dealt with in the Nov., 1922 issue of this magazine.

In Figs. 1 and 2 the tuning unit is shown to be composed of a vario-coupler and a variable condenser. This, of course, may be varied to suit the material that the maker may have on hand. Honeycomb coils could very well be used, in which case two of them should be employed, one for the primary and the other as the secondary, both of them to be shunted by a variable condenser with a capacity of .001 mfd.

In Fig. 3 is shown practically the same circuit as used in the de Forest reflex set, employing three tubes and a crystal detector, and giving the effect of three stages of radio frequency, detector and two stages of audio frequency amplification. This set may be used either with a loop or an outdoor an-

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tenna, and will give very good results with either. The connections for both are shown in the diagram.

The tapped inductance shown in series with the loop is only necessary when a very small loop is used, it need not be included if the loop wound with from eight to ten turns of wire exceeds three feet square.

The various fixed condensers shown in the accompanying diagram play an important part in the action of these sets. It is well known that a high impedance coil with an iron core will not allow radio frequency current to pass through it. Therefore, condensers are shunted across all of the windings containing iron cores to supply a path for these currents. The sizes of these condensers are not critical; they may vary from .001 to .002 mfd. without affecting the operation of the set to any appreciable extent. They should be of the best grade obtainable, for if they are of cheap construction, their capacity will tend to vary and cause trouble in the set. Mica dielectric will be found best in all cases.

In conclusion the writer would advise the experimenter to start with the one tube set; then as his knowledge of the operation of the set expands, he can increase the size first to the two tube set and finally to the one shown in Fig. 3.

"Optical Illusion" Prize Contest

(*Continued from page 236*)

3. Original material only should be submitted.

4. Optical illusions which depend on lines for producing the illusionary effect such as two parallel lines crossed by means of oblique lines, etc., will not be considered.

5. Illusionary devices which are already employed by magical entertainers should not be submitted.

Amongst such apparatus we would include such stunts as the lady with the floating head, or the half woman, etc.

6. Mirrors of any type can be used and as many may be employed as is found desirable.

7. Plate glass or ordinary window glass can also enter into the construction of the device. Distortional effects obtained by mirrors will not be looked upon as coming within the scope of this contest.

8. All manuscripts, with drawings made on separate sheets, must be in our hands before midnight Monday, August 6.

9. The results of the contest will be announced in the October issue.

10. If two or more contestants submit the same prize-winning idea constituting a tie for any of the prizes, the identical full award will be given to each.

11. Contestants may submit as many ideas as they desire. Each one will be considered separately and individually for its value.

12. The decision of the judges is final.

CORRECTION NOTICE

In the article entitled, "The Preparation of Cold Light Substances" which appeared in the April number of this journal, credit should have been given to "The American Mineralogist Magazine" for February, and particularly to an article therein by Mr. W. S. Andrews, for a number of formulas and facts given on this interesting and little known branch of science. Those interested in this subject will do well to read the above interesting article by Mr. Andrews of the General Electric Company, who is an expert in this line of work, and who has made many researches in fluoresence and phosphorescence phenomena.

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CIGAR PIPE

(719) A. Kurtz, Los Angeles, Cal., has designed a pipe in the form of a cigar, and asks us whether we would advise patenting the same.

A. The cigar pipe which you have designed is not new, and many of these have appeared upon the market heretofore. In fact, in novelty stores in New York these cigar pipes may be obtained for 15 cents minimum and 25 cents maximum. We believe that the design now found in stores is better than yours, because of the fact that a small tip resembling a bit of ash is placed at the end of the imitation cigar. This prevents the tobacco therein from receding and making the edge of the imitation visible. Of course, these cigars are not made in two parts as your diagram shows, and neither is there any nicotine collector, but in view of the fact that the sales for the same are very slight, we doubt very much if securing a patent upon your device would pay. Your nicotine collector would be extremely hard to clean and in case it became clogged the entire cigar pipe would have to be thrown away.

We would under no circumstances suggest applying for a patent for this idea, because we do not believe you would find a favorable market for the device.

REGISTERING THERMOMETER

(720) Fred W. Kunsehman, Bronx, N. Y., says he is working upon a thermometer which registers at a distant station, and desires patent advice upon the same.

A. Thermometers which indicate at a distance are fairly well known. This is particularly true of electrical thermometer connections.

Unless we know more about your device, we will be unable to advise more fully. We therefore suggest that you send a description of the system you are now working upon.

BASIC PATENTS

(721) A. King, Gilroy, Cal., asks whether basic patents are better than other patents, and what we mean by the term basic.

A. Basic or fundamental patents are of course the best, but it is rather difficult to secure such. Take, for instance, the patent on the three element vacuum tube. One of these elements is heated to produce ionic discharge. This is surrounded by another or partially surrounded, and a third element outside of this, constituting the plate, complete the tube.

Another of its claims is a device in which one or more of the elements are heated to permit the reception or transmission of radio signals. If renewable fuses had been patented in the same manner (which is of course impossible) there would have been no cause for the 80 or 100 different types of renewable fuses which now flood the market. In order that an inventor maintain his position, however, he must be ready to back up his patent claims by law suits, if such necessity should arise.

There is, of course, more than one way of accomplishing an object, and if a patent is got out in such a manner that it insists upon a positive position of placing the element, and another inventor finds a different position, which acts equally well or better, he can patent the same but the claim will not be basic enough to cover the first modification.

Take the instance of an automobile hub lock. An automobile hub lock was recently invented in which the lock was located in the front hub of the automobile and that was the first claim made in the patent. It might, therefore, be construed an infringement for any other hub lock, regardless of how constructed or how designed, to find its way into the front hub of an automobile wheel. Nevertheless, there are three hub locks now upon the market all within the front hub of the automobile. The reason may be that no lawsuits were resorted to in following up the original claims and maintaining the owner's right to place the lock in said front hub.

HEADLIGHT CURRENT REGULATOR

(722) Herman Scott, Cedar Vale, Kansas, has submitted a suggestion for electrically controlling current to the headlights of a Ford automobile. He requests our advice.

A. In view of the amount of vibration in a coil, and the difficulty of causing the switches actuated by the solenoid to operate properly, we would suggest that you have a model of your headlight regulator for Fords built, and give it a thorough test before attempting to proceed with a patent. A much better regulator for a Ford engine would be a governor upon the arm of which is a sliding contact, moving over a resistance. A suitable short-circuiting switch should be interposed, so that the resistance could be cut out whenever desired.

If you find that the device is successful in operation, we would suggest a search, and if you are in a position to market the device yourself, would advise that patenting the same would probably bring suitable financial returns. Ballast lamps connected in series with the headlights on a Ford machine, will also prevent these lights from burning out. These ballast lamps can be made cheaper than your particular device, and will function properly, regardless of the amount of current imposed upon them. You could probably design a ballast lamp to do this work, and have them built in accordance with your specifications.

TIRE AIR GAUGE

(723) John B. Souza, Honolulu, H. T., submits a sketch of an air gauge permanently mounted on each wheel of an automobile and requests our advice.

A. We do not believe that the air gauge which you have designed is of very great practical value, for the simple reason that one air gauge is sufficient for all tires. If a gauge were placed on each wheel they would easily clog with

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dirt, dust and water would ruin their efficiency. Air gauges are today being sold at 50c a piece. This is without a doubt much cheaper than you could possibly manufacture your contrivance for. The added feature of a modern gauge is that it is so small it may be carried around in the vest pocket. Another device for tires is in the form of a whistle which is set at the time the tires are to be inflated, the whistle being fitted directly over the inflating valve. As soon as the tire is inflated to the proper degree, the whistle commences to blow and greater pressures of air do not further effect the tire. We do not advise applying for a patent upon your idea because of the cost of manufacturing the same, and because of the fact that other devices of a similar nature but more efficient, are upon the market.

Treatment of Poison Ivy and Insect Bites

By DR. ERNEST BADE.

(*Continued from page 232*)

Another remedy is found in the milky sap of the milk-weed. If the infected parts are rubbed with this juice, the itching is at once relieved and further spread of the eruption is checked.

If bitten by a deer or other fly it is well to draw the blood immediately by sucking the wound; rubbing with ammonium chloride (salammoniac) is also effective.

A preventative which keeps the biting insects away consists of a strong smelling oil such as citronella, sometimes known as mosquito oil. It can be used as it is, that is, the oil can be rubbed on face and hands using little more than a trace, for this essential oil not only has a very strong odor, but the odor lasts for an exceptionally long time. It is far better to use a rag, dipped into the oil and kept at a little distance up wind if it is possible, for if it is once on the clothing, it is extremely difficult to remove its "perfume."

IODINE FOR POISON IVY

Mr. Secor, Associate Editor of this journal, has been troubled quite a bit in the summer with poison ivy, and some of his experiences in the treatment of persistent ivy poisoning are given below.

After trying all of the more common remedies for poison ivy and finding no relief, recourse was had to a physician. Luckily this physician, Dr. George Unsworth of Suffern, N. Y., had made quite a study of ivy poisoning, and his treatment of a stubborn case consisted of administering some tablets made from a poison ivy which grows in Russia, which acted to inoculate the system against further poisoning for several months. The larger blisters were then opened with a sterilized needle, taking care to pass the needle through the top of the skin sidewise, and not down through the top and into the under skin. The skin was then washed with alcohol, and some iodine salve applied, and the hand or arm was bandaged up for twenty-four hours or more. Where the poison attempts to spread and will not yield to sugar of lead or ammonium chloride treatment, it will invariably succumb to iodine, as Mr. Secor has found; in fact this was the only remedy which was successful in killing it in a short time in his case. Churchill's iodine was applied with either the cork of the bottle, or else with a small brush, making one or two applications two hours apart. Too much iodine must not be applied or it will kill the superficial cells of the skin to too great a depth, and be liable to cause a sore difficult to heal.

Some people have found success with fish brine, which can be obtained from a grocer or delicatessen store. A saturated solution of sal-ammoniac in water is very good as experience has proven, and another remedy used by several acquaintances of the editor's, is a copperas solution (iron sulphate).

One of the newest discoveries in the treatment of ivy poisoning is the use of a solution of hypo-sulphite of soda; in other words, the common *fixing bath* solution used in photography in saturated form.

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Electricity from Sea Water

(*Continued from page 225*)

depth, temperatures as low as 5° and 6° C. (43° to 45° F.), or even less, are found. This state of things is clearly explained by the poor thermic conductivity of water from above down.

Thus the water of the upper layers can be utilized in tubular boilers for evaporating a liquid with a low boiling point; liquid ammonia for instance. The vapor can be utilized in a turbine and then can be condensed in condensers through which the cold water drawn from the lower depths of the ocean, is caused to circulate.

The efficiency will be very low, because it depends on the difference in temperature of the liquid utilized at the inlet and exhaust end of the apparatus, but this will be of no importance on account of the absence of direct cost of the energy utilized.

DATA FOR 100,000 K.W. PLANT

Professor Dornig has made out the principal features of an installation for the production of one hundred thousand kilowatts, or a hundred and thirty thousand horsepower. Water at 25° C. (77° F.) drawn from the surface, passes through the tubes of an enormous boiler with a heating area of about six million square feet. The heat thus obtained would be used for evaporating the liquid utilized—ammonia—which we have suggested, and the vapor produced would drive a series of turbines of a comparatively simple construction but of very low efficiency. The vapor from the exhaust of these turbines would go into enormous condensers with a condensing surface equal to the heating surface of the boilers; through the tubes of these condensers a current of cold water at about 6° C. (43° F.), would be maintained, drawn from a depth of about three hundred fathoms through a vertical tube of nearly fifty feet in diameter, and brought to the surface into the condenser by means of powerful pumps. After the water passed through the tubes of the condenser, it would be sent back into the sea, with a temperature of about 50° F. and down to a depth of about one hundred and fifty fathoms. In contact with these tubes, the vapor would liquefy, and then would be sent once more to the boiler and other apparatus to carry out the cycle of operations just described.

All the apparatus would be contained in a gigantic barge of reinforced cement.

The turbines would drive electric generators, which would deliver the energy through cables to the shore. Various factories would utilize the power thus obtained.

It is interesting to know what this project represents from the point of view of capitalization and other expense. The capitalization of the plant would be in the neighborhood of twenty millions of dollars for the tubular boiler and the condensers; of three millions of dollars for the piping of the cold water; one million for the other conduits. The electric apparatus and cables for transmission of the energy to the shore would cost about four millions of dollars; the barge of reinforced cement would come to about two and a half millions of dollars, so that the total capitalization can be put at forty to fifty millions of dollars.

The annual expense, interest and amortization, labor, etc., would be about four and a half millions of dollars. Putting the period of operation of the plant at only 7,800 hours per annum, it would give seven hundred and eighty millions of kilowatt hours per annum, bringing the cost per kilowatt hour to a little over one-half cent.

It is estimated that such a floating plant could be installed for each sixty-two square miles of the ocean's surface.

G. MALGORN, in *Lectures pour tous.*

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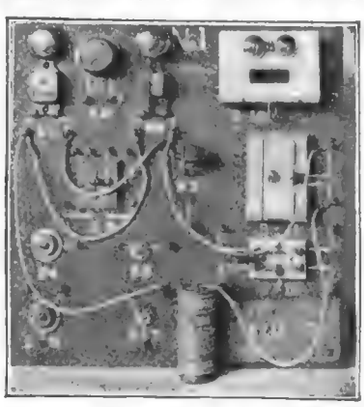

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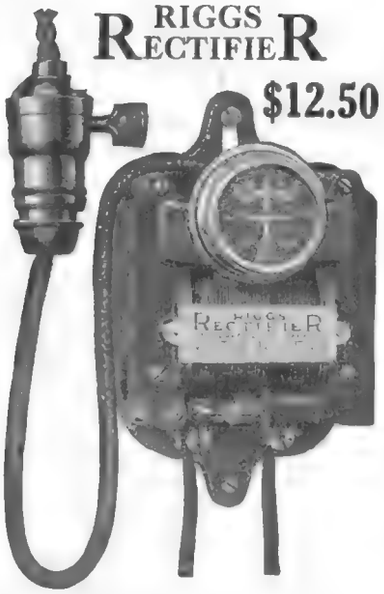

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Dr. Hackensaw's Secrets

By CLEMENT FEZANDIE

(*Continued from page 227*)

the cluck of the mother-hen calling her brood; her peculiar clucking when she has discovered a tid-bit; and the wild 'Peep' of the baby chick that has lost its mother.

"Then what in the world is it that you have done?"

"Silas, I have taught an ape to speak English! Oh, understand me. I mean that I have taught him to articulate and to comprehend a few simple phrases in the English language."

"You don' mean it?"

"I do. My first problem was to find a proper subject for my experiment. I hesitated long whether to choose an orang-outang or a chimpanzee. Both are highly intelligent and teachable. Both have been trained to perform remarkable feats. I finally decided on the chimpanzee, and I have never regretted my choice."

NEW MONKEY DEVELOPED BY DR. HACKENSAW

"Of course I must begin young. In fact I resolved to raise my own monkeys from the *egg*, or more properly speaking, the *ovum*. I chose for the parents two well trained and highly intelligent chimpanzees. I secured a number of ova from the female, fertilized these with sperm cells from the male, and raised these fertilized egg-cells *in vitro*, that is to say in glass jars containing a suitable culture fluid. My monkeys were thus born without seeing others of their species, and I could therefore train them from the very start.

"My first care was to secure a professional monkey trainer. I obtained a list of the foremost men in the business, and finally selected the one who seemed to have obtained the greatest success in training his animals. I even used some of his monkeys, themselves, to assist me in training my pets."

"You used *monkeys* to train other monkeys?"

"Certainly. All animal trainers find their work greatly simplified when they have a trained animal to serve as an example to the novices. The pupils learn by imitation. Monkeys, with their natural facility for imitation, profit even more than dogs by having a trained animal as a model.

"Then came the task of selecting the brightest of my pets. The work was too arduous to admit of our training more than one monkey. But how to make sure of picking out the best one, was a problem."

"I don't see how you could possibly tell with such young animals."

"I followed the method mentioned by Darwin as being the one used by a successful animal trainer. He always chose the animals that paid closest attention to him when being taught. An animal that is attentive and imitative is sure to make a good pupil. It is by this test that I selected Chimp from among a dozen of his twin brothers, and we could thereafter give him our undivided attention.

"He soon learned all the tricks of his pupil-teacher. He could eat properly at table; could pour liquids from a bottle into a glass, and drink from the glass; could strike a match and light a candle; could skate on roller-skates; could ride a bicycle, mounting and dismounting from it, unaided, with the greatest ease; and he could ride it in and out through a row of bottles without upsetting a single bottle. He could even undress himself and get into bed. In short he could perform all the exhibition tricks of the best-trained apes of Europe and America, for I secured the services of these as instructors."

"What was the use of teaching him all these tricks?" asked Silas, puzzled. "As you merely wished your pet to learn to speak English, and didn't intend him for exhibition purposes, what on earth was the sense of teaching him all these useless things?"

"Ah, Silas, there you make a common mistake. It is to the greatest advantage for a teacher to have a docile pupil, accustomed to obey. Chimp learned from these early lessons that some task was expected of him, and that different signals had different meanings. It was a pleasure for him to imitate the trained apes. He enjoyed bicycle riding immensely and would often accompany me for a ride around Central Park, where we naturally attracted considerable attention. These apparently useless lessons proved of the greatest value."

HOW THE APE WAS TAUGHT HUMAN LANGUAGE

"What I don't understand," said Silas, "and what specially interests me, is how you taught him human language. Your trained monkeys couldn't speak, and could therefore be of no use to you."

"You are mistaken, Silas. One of my trained apes proved useful even in this respect. Monkeys, as you may have noticed, possess a number of different cries. This ape's trainer had noticed four distinct cries possessed by his pupil; one of these was a kind of shriek; another a guttural sound; a third was a chatter; and the fourth was a sort of vowel utterance. He had taught his pupil to utter any one of these four sounds at a given signal. Chimp soon learned these four sounds by imitating this ape's cries, and he also learned to make each at the proper signal. It was his first lesson in language."

"But his cries were monkey-sounds and didn't mean anything!"

"Of course not. To give them a meaning was my next task. I must associate each of these cries with some object, and the object should be one that should possess interest for a monkey. Chimp was very fond of acrobatic feats, and in his cage were a trapeze, a swinging rope, and a ladder. I accordingly decided that his 'shriek' should mean 'ladder,' his 'gutteral sound' should mean 'trapeze,' his 'chatter' should mean 'rope,' and his 'vowel sound' should mean 'peanut.' Ladder, rope, and trapeze were removable for easy cleaning. I took them all out of the cage, then ordered him to make the guttural sound and brought him the trapeze. Next I had him make the vowel sound and brought him a peanut. Each time that we brought him the object, we repeated the appropriate sound so as to impress on his mind the association between the sound and the thing. The work required infinite patience, but my trainer and his assistants were capable men, and Chimp soon learned that when he made a certain sound, a certain object was brought to him. He thus learned to associate an object with a certain sound, and to know that different sounds had different meanings. This was an immense step in advance. He had not only acquired a vocabularly of four words, but he had learned that there is such a thing as language; a means of communicating different ideas by different sounds. At the same time that we were doing this we taught him to understand the cries when we made them, and he learned to bring us the trapeze or rope or ladder when we made the proper sound."

"But how could you imitate an ape's chatter?"

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"I secured the services of a professional animal imitator. He was soon able to imitate Chimp's four cries, and he succeeded in teaching me and the trainer to make passable imitations. Besides this, we made phonographic records of the cries, the records being made by Chimp himself, and any of our assistants was then able to make the proper cry by means of the phonograph."

"That was clever, but as I understand you, these four words were nothing but monkey chatter. I thought you said you had taught your chimpanzee to speak English?"

"So I did."

"The thing seems impossible. You have accomplished many marvels, doctor, but if you have taught a monkey to speak English words, you have beaten all your other inventions to a frazzle. How could you possibly do it?"

"The problem was not so difficult as you might imagine, Silas. Have you ever met a deaf-mute?"

"I can't say that I ever had the pleasure."

"Well, a deaf-mute is a man born deaf. Not being able to hear, in former days he remained dumb all his life. But, of late years, it has been found possible to teach these deaf-mutes to speak. The teacher slowly and distinctly articulates the sound or word he wishes his pupil to make. The pupil sees the lips, mouth, and tongue move, and tries to imitate the motions. The teacher assists by touching the pupil's throat or lips, to show him which of the vocal organs to move. In this way, the unfortunate deaf man is taught to speak. As he is handicapped by the fact that he never hears his teacher's voice or the sounds he makes himself, there is always something peculiar about his speech."

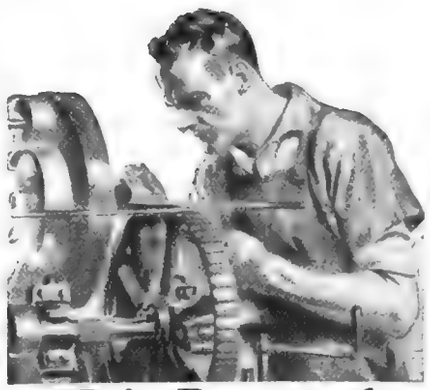
"I see."

"The idea struck me that an ape could be taught in the same manner. I accordingly visited several deaf-mute institutions, and succeeded in finding an experienced and capable young teacher, who was eager to try the experiment of teaching a monkey to speak. So the lessons began. Very simple sounds must be used at first. As a baby's first words are "ma" and "pa," I chose these as the first to teach Chimp. I used 'ma' for the word 'man.' It represented for Chimp any of his attendants. One of us always came to him whenever he made the word. The word 'pa' was used for 'banana,' as he was very fond of this fruit. 'Wa,' for 'water,' was soon added. In this way he learned to articulate and use three words, that, while scarcely English, were yet not monkey chatter.

"I won't weary you with all the details of the work. Great patience is required to teach a baby to speak—a much greater patience was required for one word. But we persevered, relaying each other. The first few words were the most difficult to teach. After that, as he began to realize the value of language for making his wants known, the task became easier, and one word after another was added to his vocabulary. The first words taught were all nouns. Then a few words were added, such as 'sit,' 'stand,' 'ride,' 'being,' etc. The process used was very much like that used in teaching a baby, with the added difficulty of manipulating the ape's vocal organs so as to get a sound approximating human speech. Even now, there is something gutteral in Chimp's speech, and it is only those familiar with his accent who can readily understand what he says. But perhaps you would like to meet Chimp in person. If so, I will call him."

So saying, Doctor Hackensaw took up his telephone:

"Hoochie," said he, "Please bring Chimp here."



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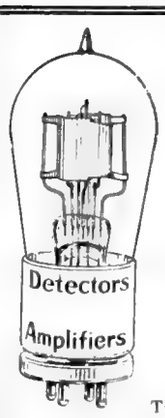

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I MEET "CHIMP"—THE TALKING APE

A moment later, an eight-year-old girl appeared, followed by a large chimpanzee. Hoochie was Doctor Hackensaw's pride and delight. Like Chimp, he had raised her from an egg, or more properly speaking, an ovum. She was a dear girl, an almost perfect specimen of what such a child should be.

Chimp was dressed like a gentleman, the doctor not fancying the costumes in which trained apes usually appear on the stage. The ape bowed gravely to Silas, and extended a paw, which the reporter shook.

"Good morn—ing," articulated the ape in gutteral accents, and in a slow, precise fashion.

"Good morning, Chimp," said Silas.

"What do you want, Chimp?" asked the doctor.

"Pea-nuts," replied the ape, who had months before learned to use the word "peanuts" in place of the earlier learned word "pa."

Doctor Hackensaw laughed, and drew a handful of these from his pocket, and handed them to the ape, who began eating them with great gusto.

To say Silas Rockett was amazed would be to put the matter mildly. Of course, Chimp's vocabulary was strictly limited and could not compare with that of a child of four, but he could understand and use intelligently a number of words of the English language. Doctor Hackensaw had certainly accomplished a miracle!

It was at about this time that Doctor Hackensaw was obliged to make a three months' trip to Europe, and during his absence, Chimp disappeared mysteriously, and no trace of him could be found, though large rewards were offered for his return. For four months nothing was heard of the intelligent animal, but one morning Hoochie was awakened by a hairy paw laid upon her, and was overjoyed to find that the lost ape had returned. He was sick and in poor condition, and a broken chain fastened to a metal band around his waist, showed that he had been kept a close prisoner. What had happened to him during his absence was never entirely known, but the following facts were gleaned. The leader of a gang of criminals had learned about Chimp, and realizing that such an animal would be of great use to him in his profession, had decided to steal him. But how?

His business had taught him the power of "The Eternal Feminine." He hired a female baboon, and, with her aid, he lured Chimp away and made him a prisoner. The ape was well fed and well-treated, but was kept in close confinement while he was taught the trade of burglary. Evidently he made a valuable ally. There was not a house he couldn't scale by means of the rain-pipes or window-mouldings. He was taught to push aside the catches of a window by means of a knife, so as to gain access to the interior. He was taught how to rummage through drawers for jewels and other valuables, though, it must be confessed, his plunder often contained worthless articles. His ability to speak and understand made him a valuable auxiliary in this work. Sometimes he hauled up and fastened a rope ladder, so his new master could follow him. In this way many houses were plundered, and as the thieves took away the rope-ladder with them, the *modus-operandi* of these burglaries was a great mystery.

Many a time Chimp had wished to return to his first master, but every attempt to escape was frustrated. But one day, a link of his chain happened to give way, and Chimp profited by the occasion to return home. Doctor Hackensaw, back from Europe, was delighted to see him again.

And then came Chimp's last exploit. Within a week after his return home, Doctor Hackensaw's house caught fire one night when the doctor chanced to be out. It was never definitely known how the fire occurred, but it was suspected to be the work of the gang, in an effort either to recapture Chimp or to kill him in order to prevent his betraying them, by leading the doctor to their haunts.

Whatever the cause, when the doctor returned home at midnight he found the place in a blaze. For some reason the fire-engines had not yet arrived.

Doctor Hackensaw's first agonized thought was for his eight-year-old little girl Hoochie, fast asleep in the burning building. It was impossible to reach her without a ladder, and no ladder was in sight. At this juncture Chimp appeared at one of the windows and clambered dexteriously to the ground by means of the rain-pipe. He, too, had been asleep, but the smoke had awakened him.

"CHIMP" BECOMES A HERO

The doctor's face lighted up at sight of the ape. Here was his one ray of hope.

"Chimp—Bring Baby!" he cried. "Baby in bed. Bring Baby!"

"Baby" being the name by which Chimp knew Hoochie, the intelligent animal understood at once what was wanted. With a bound he was back at the leader-pipe clambering up it and across the window mouldings till he had reached Hoochie's window. Many a time had he made the ascent before to awaken his little mistress, who always slept with the window open.

Now, however, the room was filled with flames and smoke. But the courageous ape plunged through the fire, and grasping Hoochie, who lay insensible on the bed, half suffocated by the smoke, he carried her to the window, and, carefully holding his precious burden, began the perilous descent. Fortunately the leader-pipe was strong; it stood the double burden it had to bear.

The heroic animal reached the ground in safety but was so badly burned that it died of its injuries the following day. Doctor Hackensaw was inconsolable, and Hoochie deeply mourned the pet that had saved her life.

In after years, whenever the doctor told the story of Chimp's heroic devotion, he invariably added:

"I have always been deeply thankful that the idea occurred to me to teach this ape to speak and understand English. I was thus able to make Chimp understand where Hoochie was, and what I wished him to do. Without his knowledge of language I should have lost this dear girl—the most precious of all my treasures."

Airplanes Make Relief Maps for Electric Co.

Airplanes are now being used by the Public Service Electric Company of New Jersey, in the making of maps, according to announcement by the corporation recently. As in the World War, the airplanes fly at an altitude of 10,000', taking photographs that are later pieced together and developed into relief maps showing important buildings, hills and rivers on a scale of 800' an inch. These are six times larger than the National Geographic Survey maps.

A map is now being made of the company's territory in Southern New Jersey preliminary to the laying out of new transmission lines. A map was recently completed showing meadows from Newark Bay up the Passaic River to Passaic and Paterson, and another is practically completed including the Kill von Kull, Bergen Point, Bayonne and part of Jersey City.

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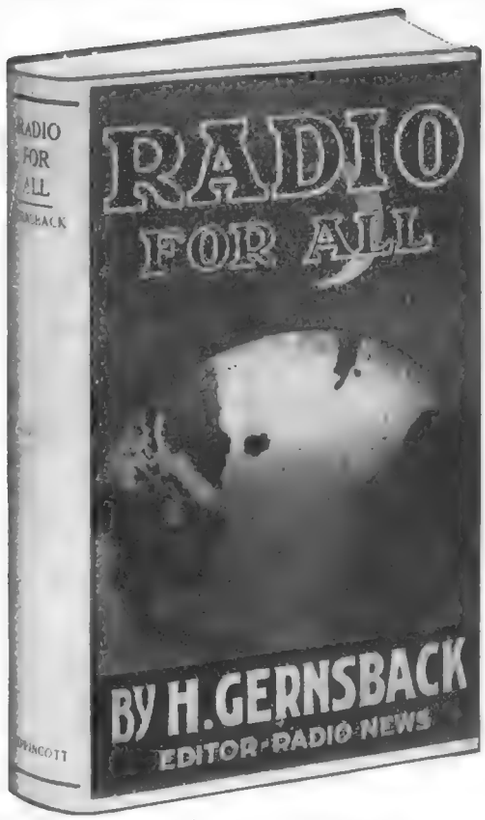

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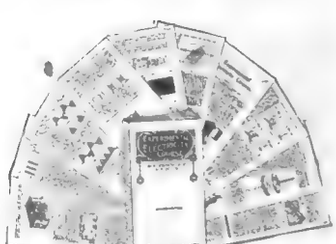

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Popular Astronomy

(*Continued from page* 304)

well-known division of stars of various types into giants and dwarfs which is so easily explainable under the Russell-Eddington theory. The chief difficulty that has to be met by the latter theory has to do with the pre-giant stage of a star's life. It gives us no clue as to the origin of the red giant stars that start the evolutionary chain. Red stars and nebulosity are never associated in space. These red giants are more widely scattered over the heavens than stars of any other type but they stand alone. No nebulous wisps emanate from them as is the case with the helium stars. It has been suggested that they have been evolved possibly from dark nebulae, but although the helium stars are frequently found at the edge of the dark caves or lanes in the gaseous nebulae, which represent the non-luminous type of nebulae, there is never a similar association between the dark nebulae and the red giants.

The Russell-Eddington theory of stellar evolution is by far the best we have.

Yachting Ashore

By MYRTLE GROVE

(*Continued from page* 219)

he starts, and the result is a twenty-two foot yacht on wheels.

This novel land ship contains a powerful radio outfit, for both sending and receiving, a steam table, refrigerator, folding wash basin, hot and cold running water, chemical toilet, luxurious cabin with berths for four by night or observation chairs for six by day.

The pilot house is entered by a flush door at the right. The compartment is about six feet long by five feet wide and gives access at its after end to the luxurious cabin, which is 8 feet long. The controls on the dash include 15 dial gages, 19 steam-valve knobs, and a number of "doohickies" which only the owner and his crew of three understand. Here is regulated the steam and electric heating systems, the hot and cold water supply, the steam cooking table and percolator, the various lights outside and inside, and the operation of the engine. Beside the steering wheel are the wireless controls, enabling telephonic sending over a radius of fifty miles or code sending up to a thousand miles.

Magic for Everybody

(*Continued from page* 270)

cealed in the bait and will not become visible until pressure is applied to the rubber ball. The air therein is forced through the thin piece of tubing into the rubber fish, and brings it to view.

The genuine, or live fish, are concealed in a compartment in the fishing basket. These fish are kept alive inasmuch as they are held in a nest consisting of moistened blotting paper. I believe my readers have guessed the method of presentation. The first fish is brought to view by a pressure on the rubber ball. In the act of removing it from the line it is in reality exchanged for one of the live fish which has been secretly held in the magician's hand. He has gotten possession of the fish under pretense of removing a bit of bait from the basket. It is this live fish that is naturally dropped into the globe.

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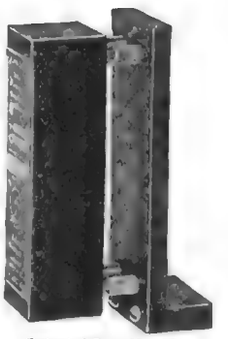

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Type	Wavelength range	Price
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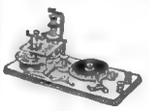

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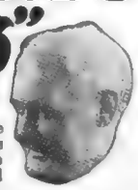

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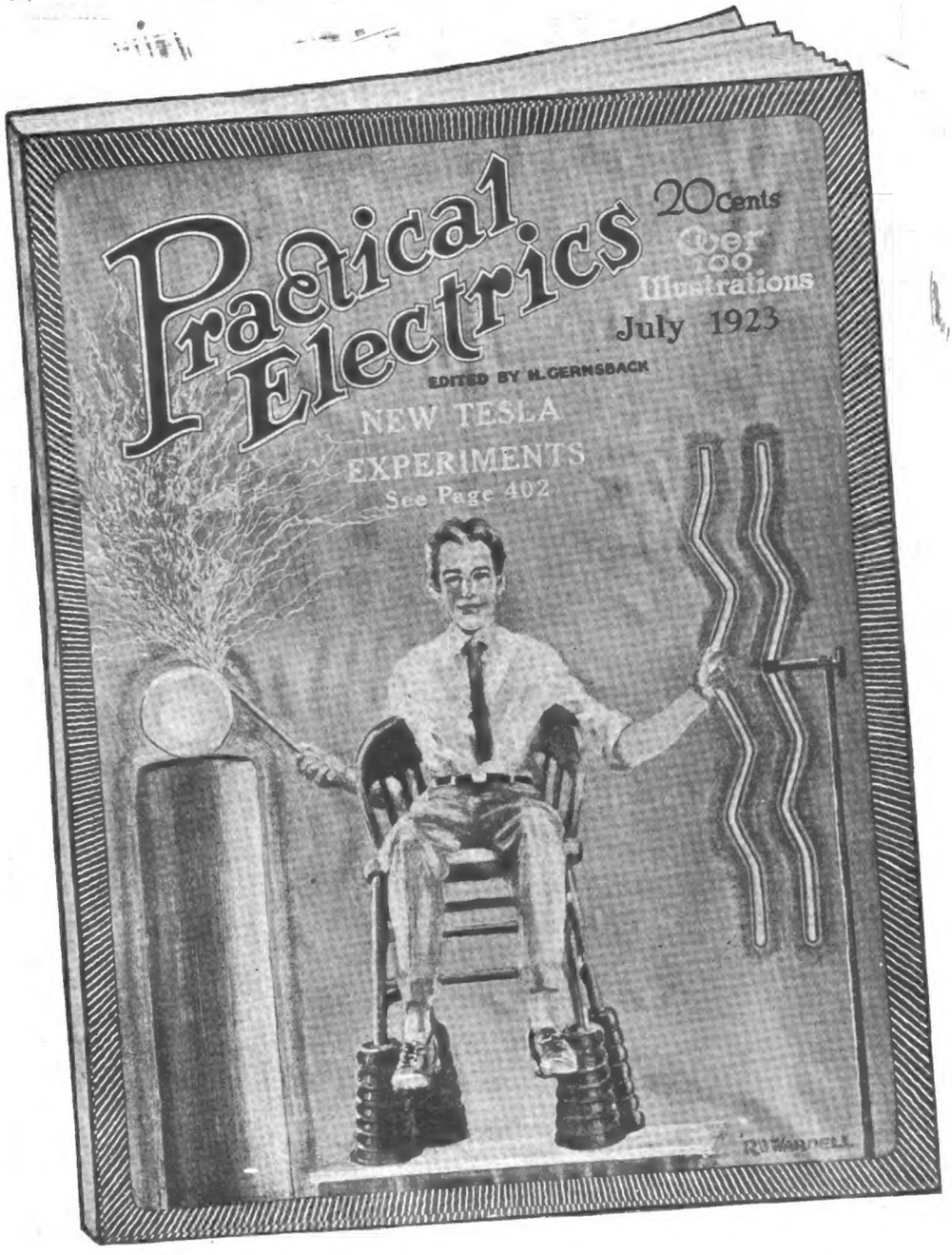

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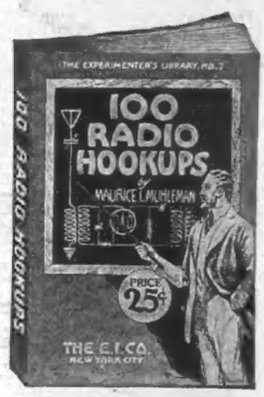

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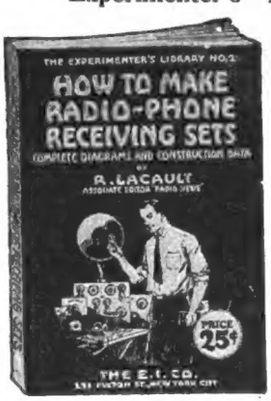

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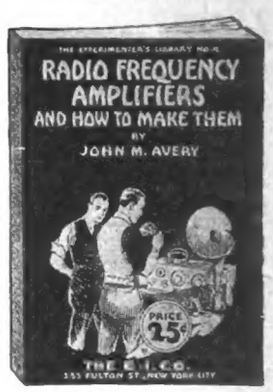
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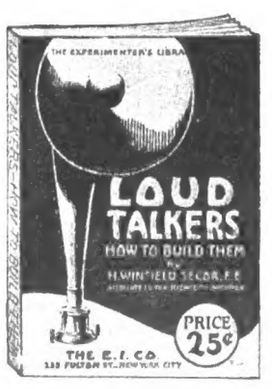

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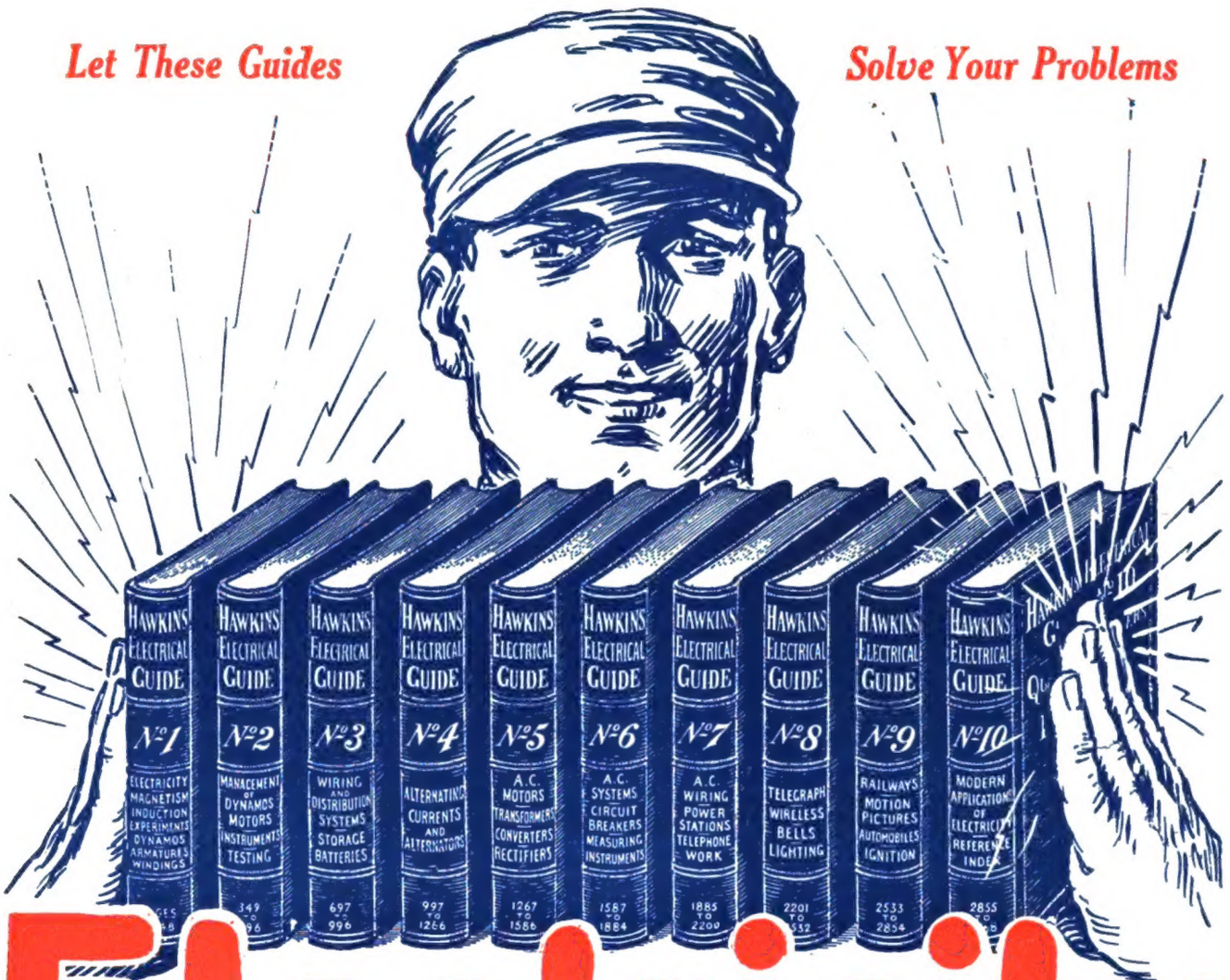

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